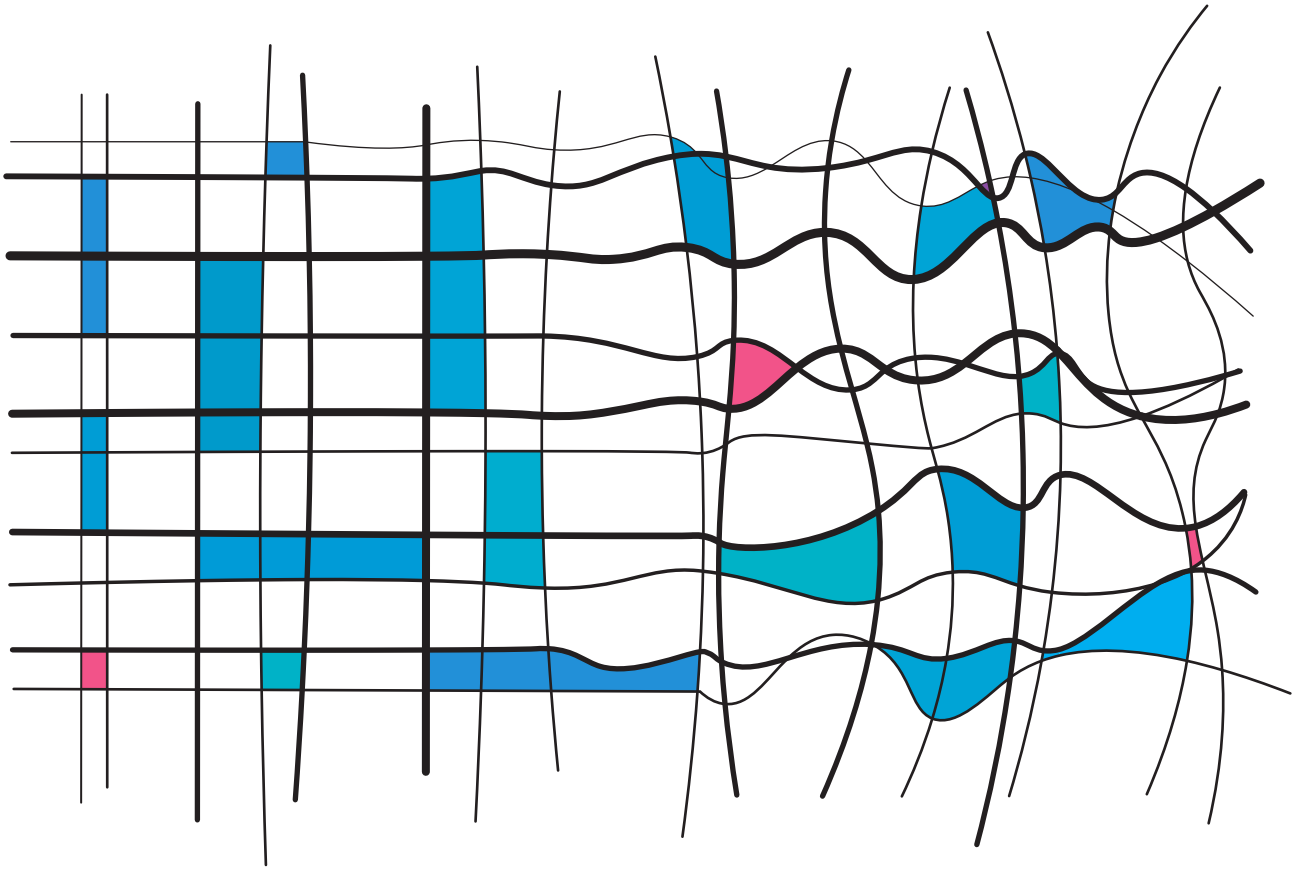
braiding time

in search of sounds from within



nicholas morrish

A THESIS

submitted in partial fulfilment of the requirements for the degree of

DOCTOR OF MUSIC

(Composition)

ROYAL COLLEGE OF MUSIC

2020

TABLE OF CONTENTS

Abstract

Braiding Time: In Search of Sounds from Within

This commentary reflects upon my search for sounds that emerge from within materials, rather than those imposed by structures from without. Through a discussion of the portfolio of works, I address how this led me to a renewed understanding of musical form. I document how an initial exploration of proportional structures became increasingly disrupted by the vitality of sound materials, and how my process evolved in recognition of this. Over time, a particular way of thinking about my compositional practice came into view. Braiding is conceived of as both a creative method and a way of thinking about form– a means of binding my craft with and within the flows of materials, and of creating sonic interdependencies in a work. My approach draws widely on both composers and theorists, including Eliane Radigue's treatment of time, James Tenney's harmonic trees, Tim Ingold's ecological anthropology and Siegfried Zielinski's medialities. In the first phase of research, a gradual drifting away from metered time is discussed through theories of rhythmic entrainment. Secondly, pure-ratio tuning systems are discussed as a means of creating frequential relationships. Lastly, the grain, spectrality and atmospherics of sound media are discussed in relation to theories of mediation.

Acknowledgements

Over the course of the last five years, I have been privileged to work with many brilliant, dedicated musicians– Catchpenny Ensemble, Ensemble Intercontemporain, Ensemble Offspring, Insomnio, International Contemporary Ensemble, the London Symphony Orchestra, Nathanael Gubler, Gina Lee, Anna Astesano, Mirko Jevtovic, Aleks Kolkowski, Heather Roche, the Royal Scottish National Orchestra, Schallfeld and the United Instruments of Lucilin. I am humbled by the teams of people who dedicate themselves to the support and promotion of new work, and whose generosity I have been fortunate to receive– the Gaudeamus Foundation, Impuls, Ircam, MATA, the Mendelssohn Foundation, the Performing Rights Society, Score Follower, The London Symphony, The Los Angeles Philharmonic, the Regional Government of Styria and The Royal Philharmonic Society.

I would particularly like to thank Dr. Jonathan Cole for his tireless work, honesty and unwavering support throughout my time at the Royal College of Music. I would also like to thank Dr. Natasha Loges for her generous encouragement and advice. More latterly, I am grateful to Prof. Chaya Czernowin and Prof. Hans Tutschku whom I had the great privilege of working with as a fellow at the Harvard University Music

Department in 2018–19. Your guidance meant so much at a critical time in my development and helped me to take my work in exciting new directions.

To my dear friends and colleagues– your work is a continual source of inspiration and motivation.

Finally, to my loved ones– Hilary, Andrew, Tim, Annah, Oenone, Gabriella, Jess, Eddie, and my wonderful partner, Sonja. Your unconditional love and support have made this possible. This is dedicated to all of you.

List of Figures

Portfolio Materials

1. *507 Mechanical Movements* (2016) 8’

   Score: https://drive.google.com/open?id=1iBmw5Kg_ZaKVuti6t7ZYmfm-vzC8gOlD

   Recording: https://drive.google.com/open?id=1K4hR3dqXd__bBEhL7GEuU6bwUCzGlLaf

2. *Grain of the Voice* (2016) 11’

   Score: https://drive.google.com/open?id=1xjykTT98aAArRN0G7ak-UvsyLXYPVLTO

3. *Life of Lines II* (2017-18) 14’

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   Recording: https://drive.google.com/open?id=160lY2iXddk96c-7Odk2S-Obd92TD4B43

4. *Our heads are round, so our thoughts can change direction* (2018) 7’

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   B: https://drive.google.com/open?id=1CbBAT3cFsihdXZdtPGfufMXbWC-c4-nj

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   B: https://drive.google.com/open?id=1Qi_T0gm3SmaZMOaBrYRjTo0EqlzrRDe6

5. *I contain multitudes* (2017) 5’

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   Recording: https://drive.google.com/open?id=14FucJoOpnVXYmvj7o-H8FKKucVnFWzsC

6. *Black sun rotation* (2018) 5’

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7. *Raw* (2018) 8’

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Recording: https://drive.google.com/open?id=1N-zswBoBD9ROSGVOycsxDVCaxLFz-xDt

8. *The traces that remain* (2018) 14’

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Video: https://drive.google.com/open?id=1CHKJ-UEGP2egUkFWbmWjC4nyKvf7EoXj

9. *Starfish Prime* (2018) 8’

Recording: https://drive.google.com/open?id=1DHThgO8jg-awkFaA-ULKBKNYZ5GUFeXF

10. *Yokobit* (2019) 6’

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Recording: https://drive.google.com/open?id=1x4aFAXBPSd-5m0pJB5SUL5r71Y-80kZc

11. *Angel | Animal* (2019) 11’

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Audio: https://drive.google.com/open?id=1Rsnc3yHdi1DKrLTQkuMrnFV3DpKYcQq7

12. *Projections in Real Time* (2019) 20’

Score: https://drive.google.com/open?id=1-7M3WbN8LeV4cqWN-L40EN3DjF5d8dCF

Video: https://drive.google.com/open?id=1uRjMq4YobafIB7mu-wETBpyHfZNF5KJR

Audio: https://drive.google.com/open?id=1IaSKI5QiW_JA0N_Cc7NeFPQnzzy3gjwC

13. *Sunset, melt, down* (2018-20) 12’

Recording: https://drive.google.com/open?id=1IQzNLpJOWVku8LRzPg1FzLUnxV6XHS9B

2h09’

Introduction

In the autumn of 2014, I arrived at the Royal College of Music with the intention of searching for meaningful relationships between frequency and time, materials and form, structure and intuition. I had a sense of what I was hoping to achieve, namely, to find sounds that emerge from within materials rather than those imposed by structure from without. In this search, I often found myself producing something quite other; proportional structures which exert an intentional force upon the flow of materials (fig. 1,2). Like the weaver who follows a rhythmic pattern of movement to produce a textile, the gardener whose espalier supports and directs the growth of a tree, or the software engineer who imposes a conceptual framework on the components of a system,[1] these structures deliberately guide my subsequent working with sound. It is when I began to realise that sound materials often resist these structures– that alternative patterns of movement can be intuited from them, that I became deeply fascinated. Consequently, I sought out unstable sounds that do not flatten easily to notation and that resist having conceptual forms imposed upon them. My work became about recognising a material's vitality and discovering

[1] see (Gelertner, 1991) for a discussion of this in relation to software.

the point at which formal frameworks become redundant as a piece unfolds. Over time, I began to conceive of my work as a form of braiding– the aligning of structural intentions within the forces and flows of materials and the weaving of sounds in and among one another. My work was in determining the strength of their bond and deciding whether a form should remain intact or unravel into tenuous threads. In this commentary, I explore how notation, analytic models, tuning methods and formal processes are used throughout the portfolio of works to investigate this. More abstract questions, such as whether time proceeds along a line, where form starts and structure ends, or if materials emanate memories, are explored in relation to the works that prompt their emergence.

Figure 1 proportional framework following a 'braided' pattern of movement, from section 6 of *Projections in Real Time*

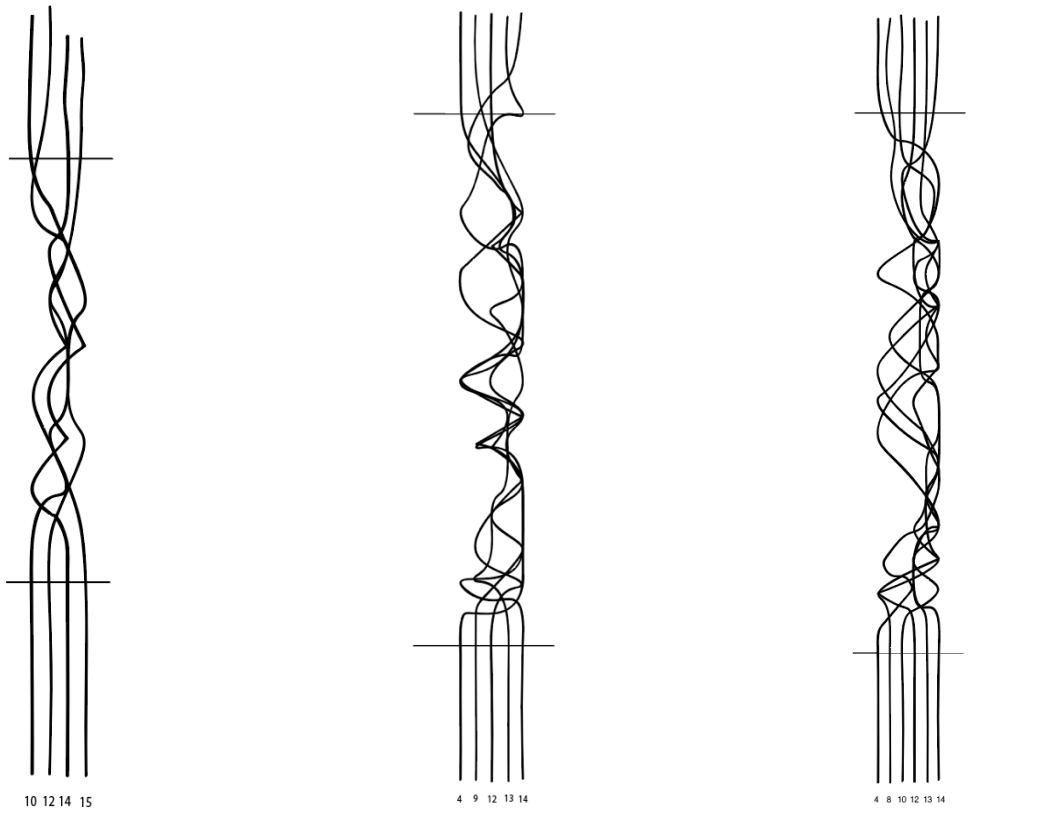

Figure 2 *Projections in Real Time*, temporal units represented as a braid, sections 3, 2 and 1 (L–R)

I began from fundamental compositional principles. What happens when a sound encounters another sound? To approach an answer, I found that I needed to address that which is in relation. What is inside sound? What is the relationship between sound and material? What is the relationship between composer, sound and material? Is all music premised upon materials entering into relationships with one another? What makes one form relational, while another merely constitutes relationships? These questions are difficult to answer, not least because our understanding of material is conditioned by our mode of access. As Tim Ingold suggests,

> 'the chemist thinks of matter in terms of its invariant atomic or molecular constitution. For the alchemist, by contrast, a material is known not by what it is but by what it does, specifically when mixed with other materials, treated in particular ways, or placed in particular situations.'[2]

On the one hand, materials might be conceived of as passive, physical, inert and invariant. On the other, they may be thought of as reservoirs of potential– knots of more or less accessible properties and qualities which emerge out of processes of

[2] (Ingold, An Ecology of Materials) 434

growth, and in negotiation with the hand of the practitioner. For the artist, the former might lead to a belief that form is the hammering of materials into conceptual schemata. In the latter, form does not issue solely from the mind but rather emerges out of a sensual engagement with materials (fig. 3).

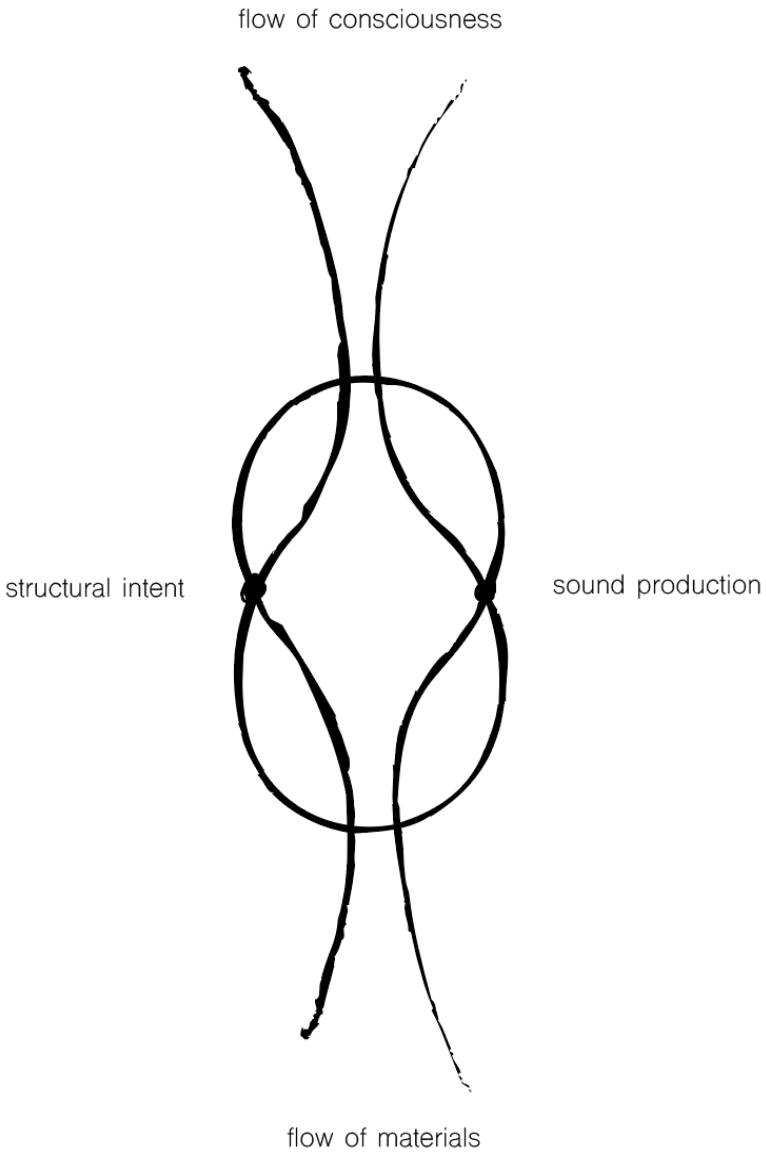

Figure 3 creative flow knot, modelled on Tim Ingold's diagram of image/object relations, *Making*, pg. 21

Throughout this commentary, I follow the latter line of thinking. I do not view materials as passive or inert, but as vibrant bundles of relations which sprawl outward to bodies distributed through space and time.[3] Thinking about this has given me cause to explore the acoustic, temporal and medial properties of materials, alongside their sociocultural histories. As I get to know a material, hazy impressions of shapes and movements in time emerge. As these become more concrete, I get a sense of how sounds might relate to one another, and whether my structural intentions can be brought into alignment with their flows. On occasion, the binding of sounds with, and within, one another produces surprising or unforeseeable results. The subject of my work here is in celebrating these moments– recognising their aesthetic, thought–provoking and form–bearing qualities.

We might call these results 'moments of sonic emergence', and I explore them here in wide–ranging and varied contexts. I discuss purely acoustical encounters (as in beating) and works that display a degree of openness in notation or synchronic alignment. I consider how generative and algorithmic structures can be subverted by the material qualities of sound itself. I also offer further examples such as the

[3] A similar line of thinking to this can be found in Nicholas Bourriaud's *Relational Aesthetics*. (Bourriaud, Relational Aesthetics, 1998) A detailed discussion of this has not been included here as Bourriaud's primary focus is on art as social exchange, and this has not been carried out to great length in my creative work.

generation of sound in the inner ear (as in Maryanne Amacher's otoacoustic emissions), the interactions of real-time composition and improvisation (as in the conducting practices of Iancu Dumitrescu or the *echtzeitmusik* scene), and the (mis)use and glitching of media to produce sounds beyond their intended format (as in the no-input mixing of Toshimaru Nakumura or the projector work of Bruce McClure). When taken as a whole, this project documents my compositional movement toward an exploration of these phenomena and practices, and the methods stumbled upon to encourage their unearthing.

Central to my work is an investigation of whether sounds require intentional force to arrive at something that feels like a form. Thus, considerations such as when to organise sound events abstractly, and when to intuit direction from the materials themselves, are discussed in detail. In this, I think about composer and programmer Laurie Spiegel's statement that "I automate whatever can be automated to be freer to focus on those aspects of music that can't be automated. The challenge is to figure out which is which."[4] Inevitably, I have not always been successful, and the balance between the automated and the intuited has been ill-struck. But gradually, a practice has emerged in which the unexpected is no longer a concession but a

[4] (Hinkle-Turner, 2006) 241

desirable outcome. Processes are met and disrupted by intuition, and agency is distributed in such a way that the breadth of possible outcomes is aligned with aspirations for the work in hand.

In the spirit of learning through making, I hope to not linger too long in theory throughout this commentary. This honours a shift in perspective as my research developed. In 2014, I began this project with a notion of what research constitutes, namely, a theoretical, text-oriented and to a degree, impersonal approach through which I sought to contextualise composition within a broader field of cultural theory. I immersed myself in this without immediately paying recourse to music, treading tangential routes without worrying about the production of sound. Inspiring as this was, I found myself increasingly engaged in rather arcane fields of study which I came to realise had been entrenching my thought. I was itching to work with sound in a hands-on and liberated way. I had been searching for meaning and context in scholarship, rather than producing both through the act of making. In the summer of 2017, my approach changed radically. I moved away from theoretical discourse toward listening more actively to the materials that I was engaging with. This is a way of thinking that is more to do with the latent knowledge embodied in practice, not, as Tim Ingold describes, 'engineering a confrontation between theories in the head and facts on the ground, but rather joining with the things themselves, in the

very processes of thought'.[5] Accordingly, I try to move through and beyond discursive forms in this commentary to give primacy to where I find most insight– as a practitioner, working with the sounds that materials and beings make. When theory is discussed, it is best understood as an idea coming into view along an ongoing path of discovery. My sources are wide-ranging, and drawn from a variety of disciplines, as a result. When a sound idea is escaping my grasp, I loop around it– circumscribing it through metaphor and reference. My intention in this is twofold– on the one hand, to accumulate meaning, on the other, to give insight into my thinking about my process. The result is a knot of reflections– an auto-ethnographic account of encounters with materials, ideas, systems and beings, discussed through the traces that have been left behind.

The conceptual premise for much of my later work centres on acoustic principles and the materials of sound production; where sound emanates from, how it is being transmitted and who or what is receiving. Unpacking this led me into an expanded field of practice in which sound media are conceived of as technologies that emanate memories, give voice to bodies distributed in space and time and draw out the sonic energies of contingent matter. As my work progressed, I became

[5] (Ingold, Correspondances, 2017), 5

increasingly engaged with sound surfaces whose associative qualities I believe render time as a material and in asking how I can make a variety of relationships between bodies and machines audible.

Along the way, I encountered the work of a number of inspirational thinkers and makers, whose influence can be felt throughout this commentary. The presence of Tim Ingold's ecological anthropology can be found between every line, with his work being a consistent source of inspiration and guidance. Siegfried Zielinski's medialities, Eliane Radigue's treatment of time and James Tenney's harmonic trees all contribute vitally to my thought. A clear precedent can also be found in John Cage, who states that the musical work is the conjugation of 'our powers of production with and within the world's self-varying',[6] and demonstrates how compositional practice can reveal sound producing bodies as fields of potential, in which the materiality of sound production is manifested through contact. This means viewing composition as more than 'the construction of an object or prefiguration of a form',[7] but as the bringing together of a 'multiplicity of forces that can give rise to a stream of continuous variation [and] constant deformation'.[8]

[6] (Pazner, 2015) 61
[7] (Pazner, 2015) 45
[8] (Pazner, 2015) 45

RESEARCH PHASES

My portfolio is grouped more or less chronologically, and in three distinct phases. I now consider the works included in *Drawing Along*: *Entrainment* (Phase 1) and *Tuning in: Temperament* (Phase 2) as preparatory studies for those found in *Among: Mediation* (Phase 3), where methods were more fully developed, synthesised and latterly abandoned. Over the course of the portfolio, there is a notable shift away from discrete rhythmicity and metre, overt gesturality, bound pitch structures (sets, rows etc.), virtuosic instrumental technicality and classical notation. These are gradually superseded by a conception of both harmony and rhythm as emergent properties of oscillation, the use of action notation to denote corporeal activity, and space–time notation to gently demarcate temporal flow.

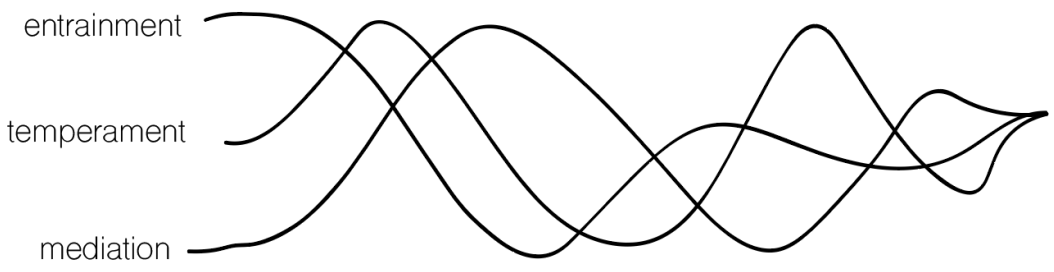

Figure 4 research phase flow diagram, demonstrating how the three core subjects of my work intertwine over the course of the project

DRAWING ALONG: ENTRAINMENT

In the first phase of my research, I conceive of the ensemble as a meta-mechanism, a causal chain or a braid of slowly evolving sonic continua. I utilise quasi-automated algorithmic compositional processes throughout, with instrumental sound being swept along by streams of information. I test the resistance of these sounds to their encoding as I explore the relationship between sound, process and 'the grid'. Gradually, I drift away from the metering of time.

TUNING-IN: TEMPERAMENT

In *Tuning*-in, I attend more carefully to the inner life of each sound and explore how frequencies relate to one another in time. *Tuning-in* is meant as both actual and figurative- a process of increasingly working with ratio-based intonation systems via diatonic harmony, but also an increasing awareness of the relational fields found within and between sound producing bodies. Accordingly, my discussion focuses on tuning and temperament. I move away from the dense polyphonic weaves found in the first part of the portfolio toward an exploration of the emergent properties of internal oscillations (such as beatings, overtones and noise).

AMONG: MEDIATION

Following on from *Tuning-in*, I became increasingly drawn to the unique acoustical imprint of the sound producing bodies that transmit tone- the phenomenal qualities of the medium. My focus shifts away from abstract organisation toward the grain, spectrality and atmospherics of sound-producing technologies. My work builds upon and extends the thinking found in the previous two phases. Ratio-derived tuning systems are combined and overlaid. Process is disrupted by intuition and resisted by both the materiality of the instrumental body and by spontaneous performative decisions. My notation progressively becomes a means of enabling co-creativity. By the final pieces in the portfolio, the sound world of my work is increasingly electronic, with the microphone being used as a mediality to open up the world inside sound.

This commentary starts somewhere in the middle, with my thoughts on making. Like most of that which is discussed here, this is heavily indebted to Tim Ingold. *Making* is discussed initially, rather than say composing or creating for a number of

reasons.[9] While I am not overly averse to these terms, I rather am to their implication that form is prefigured and enacted– a placement of sounds within (pre-existing) forms decided upon by the composer. Making, on the other hand, suggests a humbler, craft-oriented participation within a world of active materials. As Ingold describes,

> Far from standing aloof, imposing his designs on a world that is ready and waiting to receive them, the most [a maker] can do is to intervene in worldly processes that are already going on, and which give rise to the forms of the living world that we see all around us – in plants and animals, in waves of water, snow and sand, in rocks and clouds – adding his own impetus to the forces and energies in play.[10]

As I increasingly attuned to the way in which my structural intentions are braided within the flow of materials, my process changed radically. I no longer look to impose design, but rather take direction from the materials themselves. Often, materials suggest modes of handling, with form being reshaped as I work with the sounds in play. Ingold's favoured example, that of weaving a basket illustrates this

[9] This follows on from the approach to form and material espoused by Ingold in *Making* (Ingold, Making, 2013)

[10] (Ingold, Making, 2013) 21

process well (fig. 5).[11] Willowy fibres are grown, coiled, and through the application of intentional force, bent into shape as much as their physical form will allow. Each strand exerts a resistance of its own to this process. The form holds together due to the tensility of each strand, but also the interdependencies of its woven surface. Over time, the fibres fuse to form a mass which leaves no trace of its mode of construction.[12]

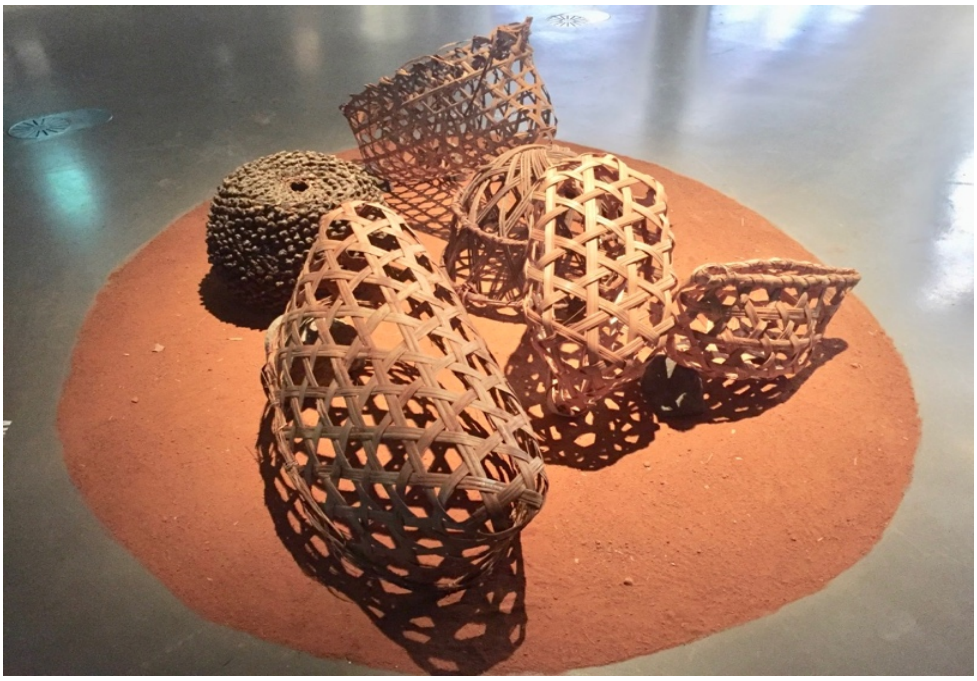

Figure 5 a variety of woven baskets, bearing more or less trace of prefigured design.

Arts–Crafts exhibition, Kunsthaus, Graz, Dec.19

It is clear from this example that form has not been imposed, but rather unfolded through the weaver's practice and the qualities of the material. Any traces of

[11] (Ingold, On Weaving a Basket)
[12] (Ingold, On Weaving a Basket) 342

prefigured design are lost as the basket is weathered by time. Equivalently, my creative practice involves sensing out the flows of material and welcoming the weathering of a work by performative action and materials themselves. These encounters redirect the shape of the work in exciting ways.[13] A variety of means are used throughout the portfolio to encourage this. For example, whilst I carefully consider the directions that can be inferred from my scores, I am increasingly looking to build incompleteness into their surface. This is for a number of different reasons, not least, that I enjoy working with sounds, materials and people, in the flesh. In this, I take on a role in part as sound director and facilitator, encouraging co-creative participation through the rehearsal process. I believe this is as much where the work 'exists' as that which can be found on the page.

In the next section, I explore my process. *Gathering, weighing, cracking, braiding, charting and dwelling* are offered as mutually informing actions that guide my work with materials, and sound itself. They are active and practical- forms of movement that facilitate encounters between ideas and materials, forms and beings. I do not

[13] There are rare instances where sound could be said to not involve encounters- tinnitus being one such example of a 'subjective' sound, but a discussion of this is not necessary here.

make claim that they are specific to my work– they address some of the fundamentals of creative activity. I offer them here as an introduction to my thinking and as a methodology, as well as a means of moving deductively toward discussion of specific themes and works later in the commentary.

On Making

'More than intangible material, than tones or words, tangible material can teach that it has demands of its own and suggestions of its own for its forming, that is asks for a reaction. Creating means this reacting to material rather than the execution of a dream, as the layman conceives it. The first vision of something to be done gives more the mood of the work than its final form. The form emerges as the work progresses.'[14]

–Anni Albers

Gathering

My compositional work is premised upon entering into relationships with materials. These materials may be concrete or conceptual, but all produce lines of enquiry along which my compositional process unfolds. I often begin by gathering recordings and improvisations, as well as collecting text, image and video (fig. 6). Initially, I try to reserve critical judgement and explore these materials intuitively. As my compositional ideas come into focus, I look for ways in which an impulse towards a material can lead to further learning, discoveries and intuitions. I try to draw out a material's physical properties, sensual qualities, personal and socio-

[14] (Albers, Textile Work at Black Mountain College, 1941)

cultural histories. I trace their lineages, listen to their stories, and proceed from outward appearances to varied engagements with qualities that may be hidden at first sight. This process continues recursively, leaving behind a trail littered with discarded threads of thought, with I then gather anew in the next phase of development. In this, the microworld of each individual piece in this portfolio mirrors the macro-evolution of my compositional project; a continual refocusing brought about through the uncovering of new forms of engagement. The unrulier and less compliant the material, the more there is to discover the next time around.

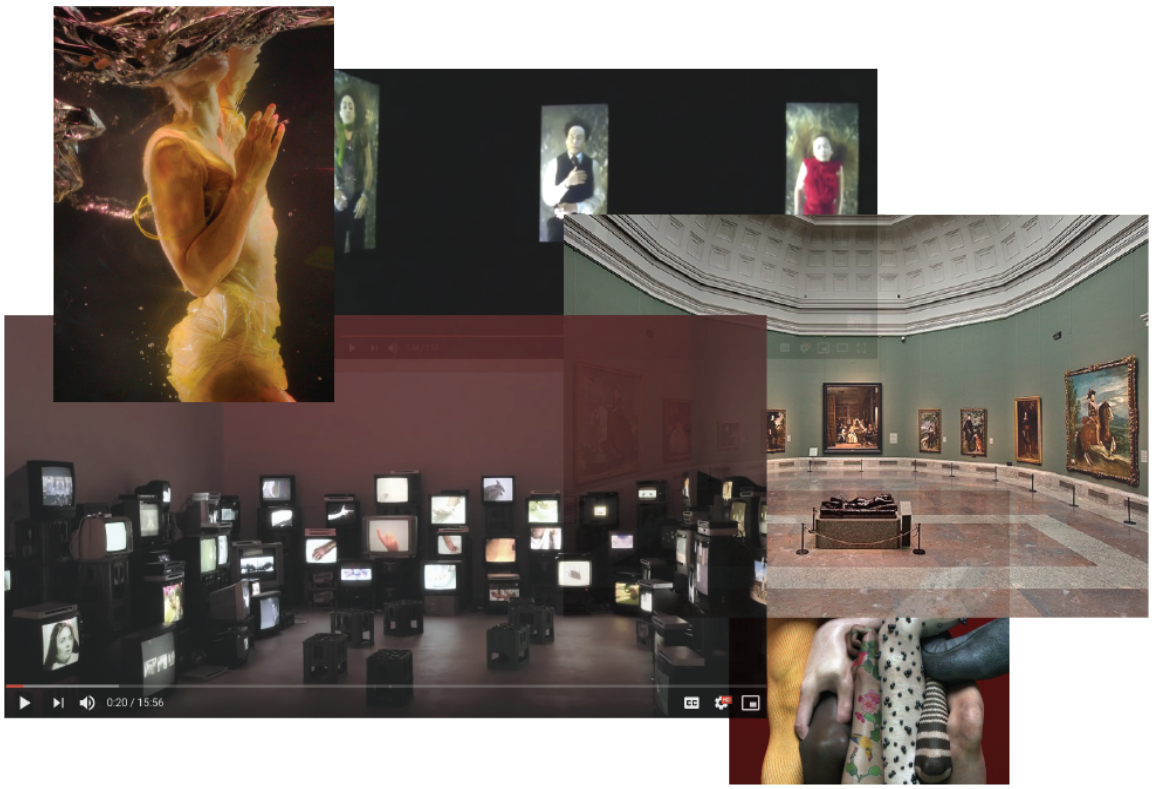

Figure 6 photomontage of images gathered for *Projections in Real Time*, including imagery from Bill Viola, Douglas Gordan and the Museo del Prado

WEIGHING

Having gathered materials together, I then spend time investigating their affordances. These may be timbral, morphological, harmonic, actional or conceptual. To explore these qualities in a rich and varied way, I often produce scales and/or categories to distribute sounds; generating acoustic complexes whose balance is dependent on the 'weightiness' of the texture that I have in mind.

Weight, in this context, can be considered to be figurative. To my mind, computer-assisted analytical tools provide a method of 'weighing' through the classification and scaling of audio descriptors (such as the temporal, spectral and energetic properties of sound events).[15] In my practice, I utilise these technologies to categorise sounds and undertake rudimentary transformations which may leaven or add density to an acoustic event. I might use denoising software or probability gating for events above a certain amplitude, creating multiple iterations of the same sound file which are more or less populated depending on the sensitivity of the meter. Or I might use the 'Q' of a band-pass filter to allow through more or less of the sound spectrum, ranging from single band filtrations all the way through to the full

[15] (Geoffroy Peeters, 2011)

bandwidth. Or I might explore timbral space through concatenative or granular synthesis, traversing the sounds which can be found within. I may use amplification in such a way that the acoustical presence of a performer is more 'weighted' toward the noise and haptic qualities of their performance, than say, their ability to produce tone. Or I might use sound as an energy to move mass, directing inaudible sounds toward a material that is enlivened by its force.

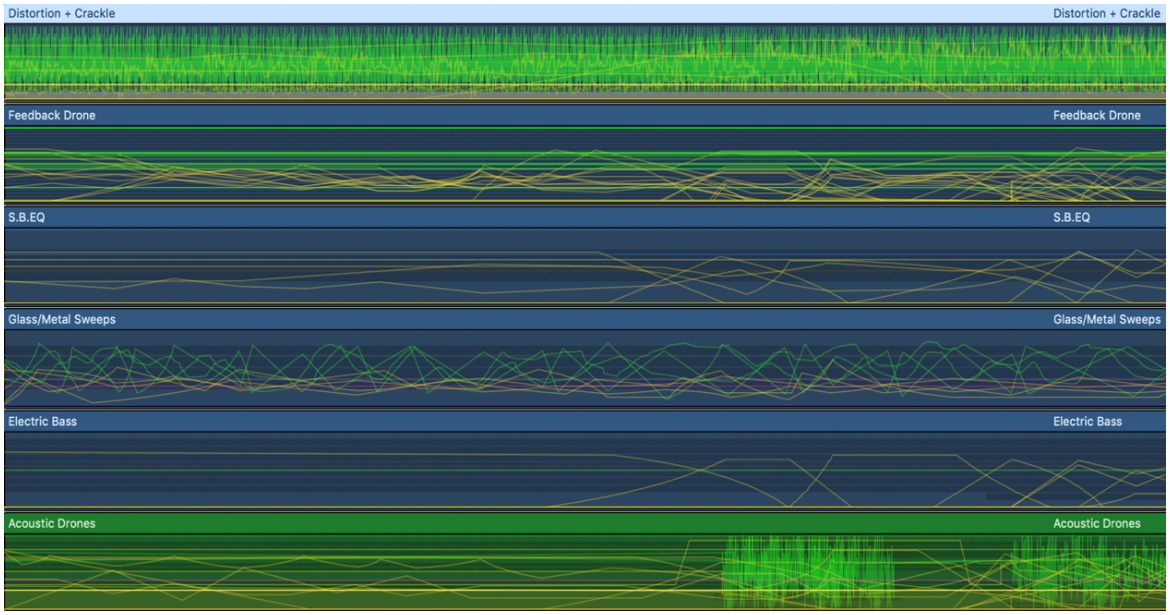

Figure 7 *Projections in Real Time* automation practices, including bandwidth filter 're-weighting'

My conception of weightiness is not limited to the acoustical plane. Deeply embedded in our language and culture is a view that art, and our emotional worlds more broadly, have density and exert a force of their own. We may speak of how an event hit us hard or broke our hearts, that we are weighed down or buried alive.

All of these statements point to the experiencing of weight on a subjective and immaterial level; an affective density that develops through engaging with art. This speaks to my understanding of cadential points– moments of arrival, unveiling or discovery. As I do not seek provision of these from classical means, I look for alternative methods. Variously throughout the portfolio, processes are played out, and with their decay I realise a re-weighting of the global texture. Sometimes, I intervene in a process, scraping away at material until a skeletal form remains. In latter works, I sheer away swathes of material to reveal materials that are bubbling underneath the surface. I also use repetition as a tool to exert a weight on our experiencing of the present.

Cracking

The surface of a material, along with all its varied associations and histories, often belies the vital material qualities found within. Take, for example, the grand piano. Its lacquered shell encases a loom of tensile strands of steel supported by columns of wood, creating vessels of resonance from which sound emerges. Or, the antenna which tunes into electromagnetic waves emitted at a distance, converting encoded fields of energy into messages that can be deciphered by a radio receiver.

To crack is not merely to rupture; it is a means of discovering that which is found within. My initial point of contact with this type of thinking was through Caleb Kelly's *Cracked Media*.[16] Kelly demonstrates how we can move through a material's commercial or intended usages in search of new creative possibilities. Breakages in signal reveal fundamental material qualities. Manipulation, modification, preparation, and destruction (fig. 8) are all methods of making the internal, external.[17] In opening up the cracks inherent in the surface of material, we can expose the dynamic interplay of its interior.

Figure 8 Milan Knízák, "Scratched Record," Broken Music Series, 1965. Photograph: Milan Knízák. Rep. from Kelly, pg. 147

[16] (Kelly, 2009)
[17] (Kelly, 2009) 3

Cracked media demand a mode of listening grounded in attending to unstable internal qualities. Over the course of the portfolio, I increasingly employ this mode to go beneath the surface of materials. Inciters (such as the circuit sniffers used in *yokobit* and *angel | animal*) listen to the circuitry of digital devices. Media, whose mechanisms are by their very nature volatile and unstable, are incorporated into performance situations (*the traces that remain*). Classical instruments are prepared and extended beyond their common practice range (*Projections in Real Time*). This led me to the interior world of acoustic and electric sounds, in which sounds prove to be much more than passive articulators of an abstract idea.

BRAIDING

To braid is to twist together, to interweave threads of material into an emergent whole. The strength of a braid's structure lies in the tensile interdependencies of its strands, brought about through a negotiation of material qualities and intentional force. Its surface is not one of smooth construction, but rather, a gathered knot of evolving contours, which bare the traces of both material qualities, and the dexterity and judgment of the weaver.[18] My understanding of this is premised on Ingold's

[18] (Ingold, On Weaving a Basket) 342

discussion of weaving.[19] Braiding is a process that takes place through time. Its form is the result of rhythmic movement (see examples of weaving notation in fig. 9, 10). A braid emerges when three or more fibres are woven with, within, and through one another, with the strength of their bond determining whether the form will remain intact. In the case of the braid, form is not a property unto itself, but rather the emergent product of interrelationships. It has no exterior, but rather is an interplay of interiors.

The braid has become the predominant way in which I conceive of process and form; a means of bringing my structural intentions into alignment with the flow of materials and creating sonic interdependencies. The rhythmic quality of this is often a fascination. I frequently look to unearth the unique temporalities of a material and explore how these can be held in relation (in other words, braided) within one another.

[19] (Ingold, Making, 2013)

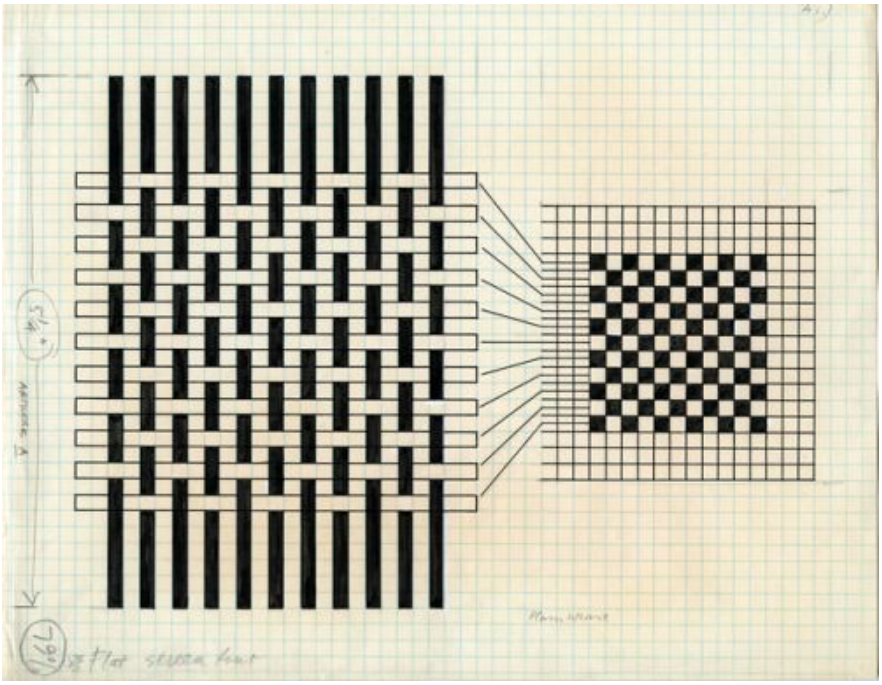

Figure 9 Anni Albers' weaving notation, rep. pg 90 (Albers, On Weaving, 1965)

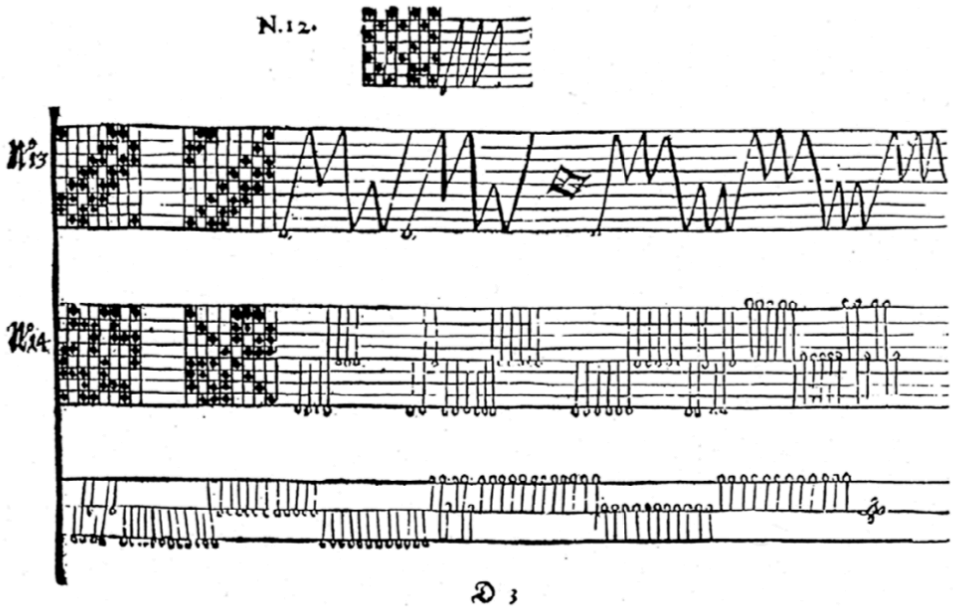

Figure 10 Marx Ziegler, weaving notation, 1677

rep. pg. 186 (Harlizius-Klück, 2017)

Temporalities emerge in a variety of ways and are not limited to the following:

CORPORAL TEMPORALITIES

Firstly, corporal temporalities or sounds that are produced and/or maintained by the limitations of the human body. For example, I often begin a new collaboration with an exploration of how much breath is required by a performer to sustain a sound, or how the length of a bow dictates phrase length, structure and sound quality. The results of this can be incorporated into a scale, in which the physical limitations of a performer inform the structure of the whole.

DEEP MEDIA TEMPORALITIES

Secondly, 'deep media' temporalities which emerge when 'archaeologically' unpacking the temporal substructures latent within an object. This requires research into the social and cultural histories of a material, the bodies involved in its manufacture, and the cracking open of the instrumental mechanism to expose the unique properties of its constitutive components. This method is indebted to Siegfried Zielinski's *Deep Time of the Media,*[20] and is used to explore materials as temporal nexuses- dream-objects which emanates memories and anticipations.

[20] (Zielinski, Deep Time of the Media, 2006)

Architectonic vectors

Thirdly (and often in combination with both of the above), I architecturally structure vectors in time. I create frameworks within which sounds can be proportionally foreshortened or elongated. I look to create situations in which a highly reduced set of acoustic events shift in and out of phase. Most commonly, I assign multiple strands of information to each instrumental body, and then overlay and recombine these to produce a dense network of possibilities. Depending on the density of this, I subject the material to intuitive processes of erasure to leave individual nodes suspended along invisible threads of information. It is the coalescing of these strands into an emergent whole that I find to be compelling. I am particularly interested in the moments when the architectural framework disappears or becomes redundant (as in Ingold's woven basket) and when discontinuities emerges from continuities. An example of this might be when an unforeseen timbral characteristic is brought into being through the interpenetration of strands of material.

Intuitive entanglement

Lastly, and perhaps most difficult to analyse, is the intuitive feeling-out of periods of time that are needed for a sound (or a silence) to reach maximal expressive

intensity. This is particularly true when working with sounds that have an 'infinitely' long attack or decay time (e.g. tone generators) as they do not conform to bodily limitations. My intuitive shaping of time is dependent on too many contextual factors to make any claim to understanding, but it seems to me that focused and repeated listening leads to a settling on a period for a sound to gain optimal density. Eliane Radigue's work, with both feedback and her ARP 2500 (seen in fig. 11), has been a constant source of inspiration for me in this regard. Works such as *Kyema*[21] and *Adnos III*[22] are resonant spaces in which the distance between inside and outside collapses. The slow transformation of material serves to both suspend time and create revelatory rates of change, with the smallest of details opening out onto new sonic horizons. In all of the above, it is in the tensility of relationships that define whether global temporality is singular or plural; whether it is directional, in suspension, or in an entropic process of fragmentation. I have sought to address this variously throughout the portfolio, and often, variously within individual pieces.

[21] (Radigue, 1988–93)
[22] (Radigue, 1973–80)

Figure 11 Eliane Radigue working with the ARP 2500 photo rep. (AMSynths, n.d.)

ATTUNING

To attune means to look through the surface of a material in search of the relational field found within. By attuning to a material, I begin to sense how I might bring a creative impulse in line with the flow of materials and infer modes of possible action.

Over the course of this portfolio, I increasingly turn to the interiors of tone and the acoustical properties of bodies that transmit them. I conceive of the unique acoustical imprint of a sound-producing body as a node along a line, stretching from the pure

and resonant to the noisy, unstable and chaotic. Most often, I assign harmonic materials to sinusoids or additive synthesizers; simple tone generators that in their lack of a complex harmonic spectrum have no direct parallel in the organic world. Noise, on the other hand, is often heard as the result of haptic engagements with materials, the product of breakages in signal, or the acoustic result of the sound surfaces of analogue media. The granular and unstable profile of these sounds produce what could be described as 'interior' rhythms (e.g. the electronic sound of circuitry) and I increasingly seek these over 'exterior' rhythms which are compositionally designed. Form is the emergent product of the exploration of this sonic continuum; a line that at one end is complex and continuously evolving, and at the other, is static and singular. I view this continuum as a line which can be looped and knotted over the course of a work, creating situations in which varied acoustic qualities become entwined. These qualities become bridges to new engagements and unveil acoustic spaces for further discovery.

CHARTING

To chart is to sketch the outlines of a possibility space, mapping possible trajectories to travel along. Its fulfilment comes in its habitation; the footprints left on the ground, and by new trails that may be discovered. A chart maps a space but does not

provide definitive accounts of the time taken to traverse it, nor how to move from one region to the next. With each new encounter, fresh charts are drawn up; the story of previous encounters pointing towards new ones. [23]

I explore notation as a means of charting a possibility space. Its function is not merely instructive or about reproducibility; it is the inscription of an attitude toward materials, the transcribing of a sensory encounter through line and dot, and the suggestion of possible modes of sonic engagement. As my project progressed, I sought to question my relationship to the score, and how musicians react to the chart that is presented to them. Increasingly, I view notation as a means of facilitating interpersonal communication, inducing study and speculation, and of implicating the performer's decision making directly in the work. To this end, my handwriting has become increasingly graphic, less directed toward the authoring of hyper-specific articulations of time and timbre and more welcoming to the embodied instrumental knowledge of my colleagues and collaborators. This is often in spite of compositional intention. For example, the proportional schemes that I develop often take the form of long scale polyrhythms which would be unwieldy, if not

[23] For further discussion of charts, sketch maps and cartography, see Ingold's *Up, Across and Along* in *Lines* (2007)

unachievable for the human performer.[24] I also work intensely with instruments in the studio to gather unique sounds, and the technical means of producing them. In a reality in which rehearsal time for performance is at a premium, I have come to the view that the specificity of these materials cannot solely be where the 'music' resides, but in qualities perhaps more essential and/or accessible to the performer in question. If a performer can bring their wealth of practical knowledge to the materials that I am asking them to engage with, then the sounding result is almost always more convincingly executed.

Out of this concession has emerged an awareness of a particular type of performative engagement that I am greatly drawn to. Much of the music in this portfolio requires proprioceptive focus, a maximal pressure felt from within the performer to make the placement of sounding events meaningful within their context. It is about a sensitivity to touch, and the ways in which the internal energy of a sound changes and develops through time. Most importantly, it is about an awareness of the relationship between the body of the performer and the body of the instrument. To this end, I find the tension between compositional enactment and performative embodiment to be creatively stimulating. I now look to score design

[24] This is perhaps a remnant of my postgraduate study of Ellliot Carter's polyrhythms.

as a means of bridging these activities and enjoy the challenge of finding appropriate means of conveying engagement(s) with the material. An example of this can be found in my foregoing of discrete rhythm, and wherever possible, metered time. The majority of the pieces in this portfolio use space–time notation, in which the proportional distance between events indicate their relative durational value and distribution. I am interested in the way in which time is resultingly produced on a local level, and in accordance with each performer's intuition. Time becomes a relational entity, not a global structure in an ordered sense. My scores chart 'idealised' temporal proportions, but the material itself can withstand a fair amount of temporal distortion. In this sense, the score traces the outer bounds of temporal flexibility; it is a sketch map (fig. 12), not a GPS system.

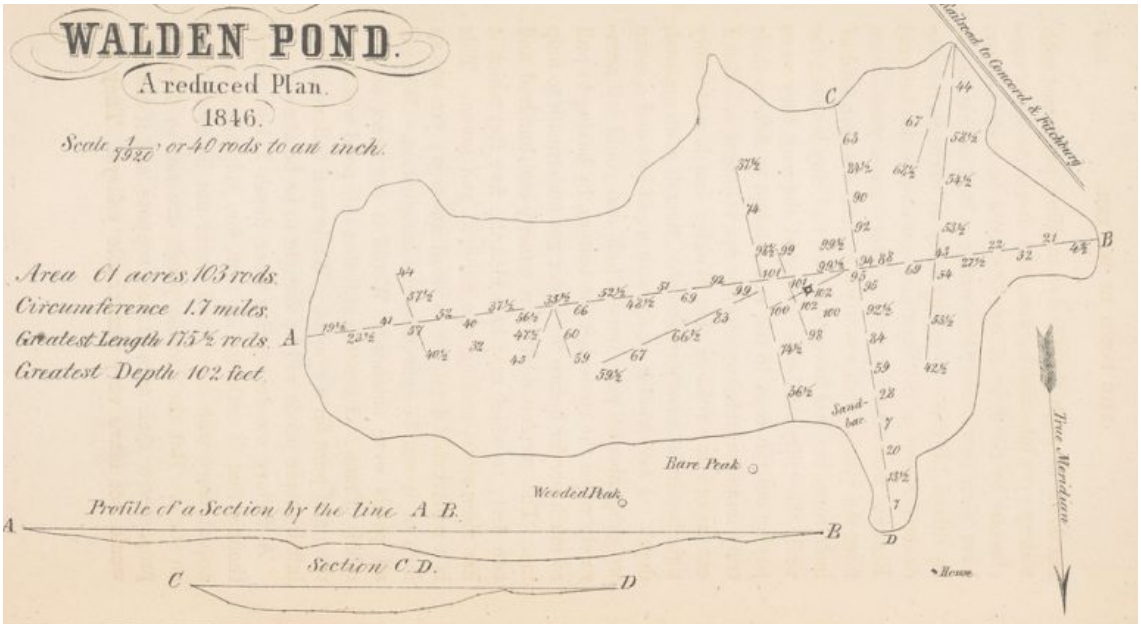

Figure 12 Thoreau's sketch map of Walden Pond (Walden.Org, n.d.)

In my music, informational overload negatively impacts the proprioceptive focus that I am looking for. I therefore seek to compress information down to multivalent symbols that indicate a number of interrelated parameters. For example, I regularly use 'morphological lines' whose thickness and shape indicate dynamic profile, morphology and period. I also use parametric staves which graphically depict the quality of the sound in question (fig. 13). They give an indication of how the sound should evolve through time in relation to specific parameters, say intensity, or density of events. There is freedom to be found in the interpretation of these notational strategies, but I do try to fairly accurately describe the onset, continuant and decay of the sound. If morphological qualities become necessarily decoupled, then additional lines of information are included (say, if the movement of a bow from *ordinario* to *ponticello* is inversely correlated with a sound's dynamic profile).

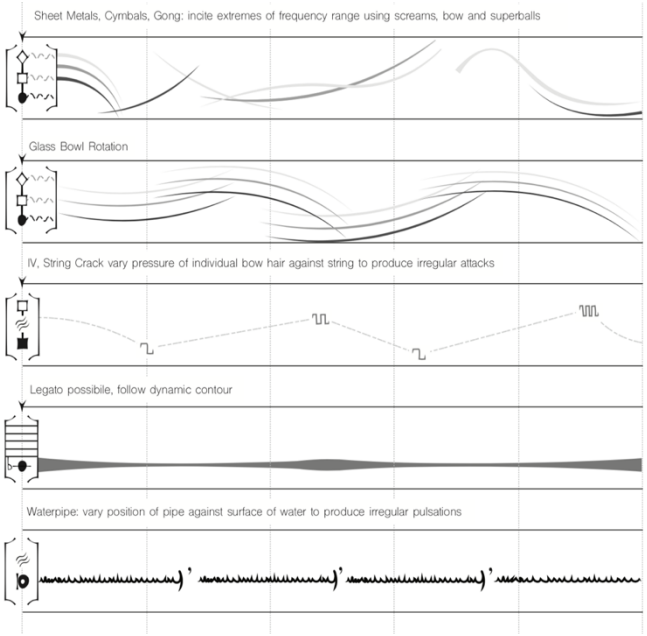

Figure 13 'morphological lines' pg.1 of *Projections in Real Time*

This type of approach becomes somewhat problematised when fixed electronic components necessitate the use of time keeping devices. As a concession, I employ clocks/counter videos alongside a cue system, to orientate the performer within electronic components. A negotiation occurs between passages in which time is a highly flexible and supple entity, and moments in which hard sectional cuts must be executed by the ensemble. The result is the segmenting of time with timecode. My feeling is that as my work with electronics increasingly moves towards hardware and live manipulation, I will replace this crude dividing of time with a method in which temporality is the emergent product of local decision making. I aspire to this and am actively looking for methods of achieving this in my future work.

Dwelling

My charts are necessarily incomplete. I build this incompleteness into my notation. I like simple instructions which bely the complexity of action, and scores that necessitate verbal communication, aural transmission and physical demonstration. My job is to create a space for performers to perceive, act and become authors of their own design. As a result, I am increasingly valuing performer's input and rehearsal time; it is the hours spent working with performers to hone performative attitude, and the choice of sound producing devices that leads to the 'habitation' or

indwelling of the chart which they are moving through. As Martin Heidegger has stated, 'only if we are capable of dwelling, only then can we build'.[25]

Perhaps a similar concern can be found in Karlheinz Stockhausen's process pieces, such as *Pole* (fig. 14). Composed in 1970 and written for radio receivers and sound projectionist, Stockhausen uses plus, minus and equals signs to indicate the relational transformation of parameters:

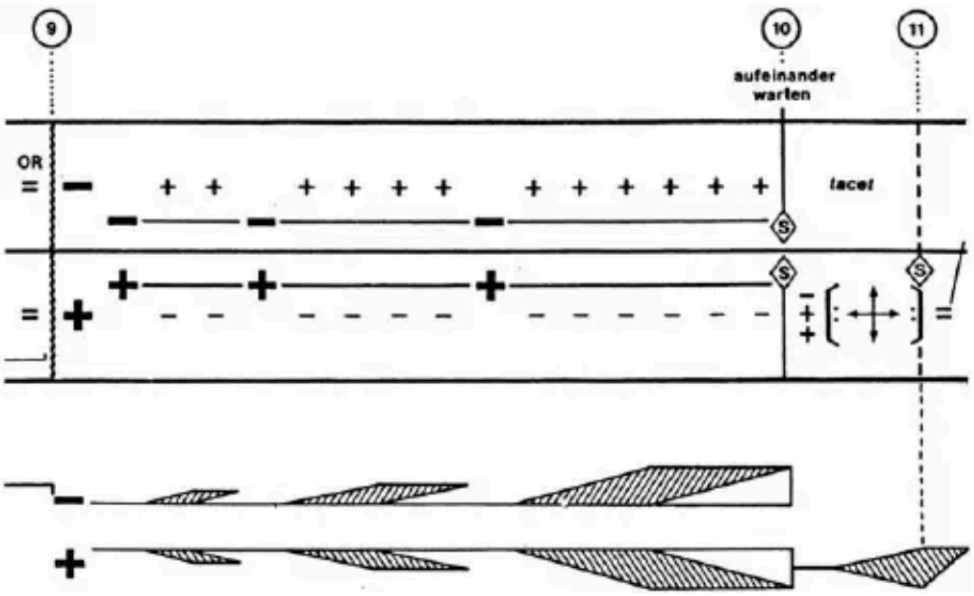

Figure 14 Moments 9–11 of *Pole* für 2 (pg.1),

Stockhausen Foundation for Music, 51515, Kuerten, Germany (Stockhausen, 1970)

[25] (Heidegger, 1971)

This symbolic language is a highly articulate means of relaying information that can be used in a variety of contexts, and with widely disparate sound producers. Perhaps I feel a kinship to Stockhausen's approach as it seeks to overcome the limitations of the classical system for notating parameters of change. For example, whilst dynamic markings may serve a purpose to suggest a particular type of bodily engagement with the instrument, they do very little to accurately denote amplitude (*mf*=*x*db. etc.) or the relation of amplitudes (*mf* performed on a kitchen whisk and snare drum=x dynamic performed on a scordatura cello). As I am increasingly working within an expanded sonic field that includes predigital and digital devices, handmade instruments and extended techniques, bodily movement and visual cues, I am looking for alternative methods to denote change. The classical system in these contexts seems akin to using imperial measurement in a metric world. Whilst I do not totally reject it (its embedded history in musical pedagogy means it still has some mileage), I am continually searching for more specific and personal methods to indicate sonic information.

Perhaps this search is also the result of a certain fondness for the graphic notation of the 1960's, particularly the work produced by composers at the Polish Radio Experimental Studio. Dobrowolski, Penderecki, Schaeffer and Kontonski (amongst others), were coming to terms with the sonic possibilities of tape music and seeking

a graphical vocabulary that would articulate frequency, transformations and event placement in a way that was more innate to an electronic medium. The scores produced were not designed for performance, but rather to be used as *listening* maps (fig. 15) in conjunction with the auditory documentation of the works.[26] There is a certain resonance to be found here in their approach and my own, particularly in works that include electronics. In these pieces, acoustic material is produced in relation to that which is heard. The sonic information (intensity, granularity, energy profile) in the electronics should provoke an instrumental engagement where complementarity is sought.

At this stage in my work, I am not looking to distil my notation into a common practice. When limitations are encountered, new modes of engagement are sought. As I move towards more collaborative work, in which relational listening practices are foregrounded, notating has become about inscribing my attitude to materials and charting these in such a way that stimulates the imaginative world of the performer.

[26] (libera, 2014)

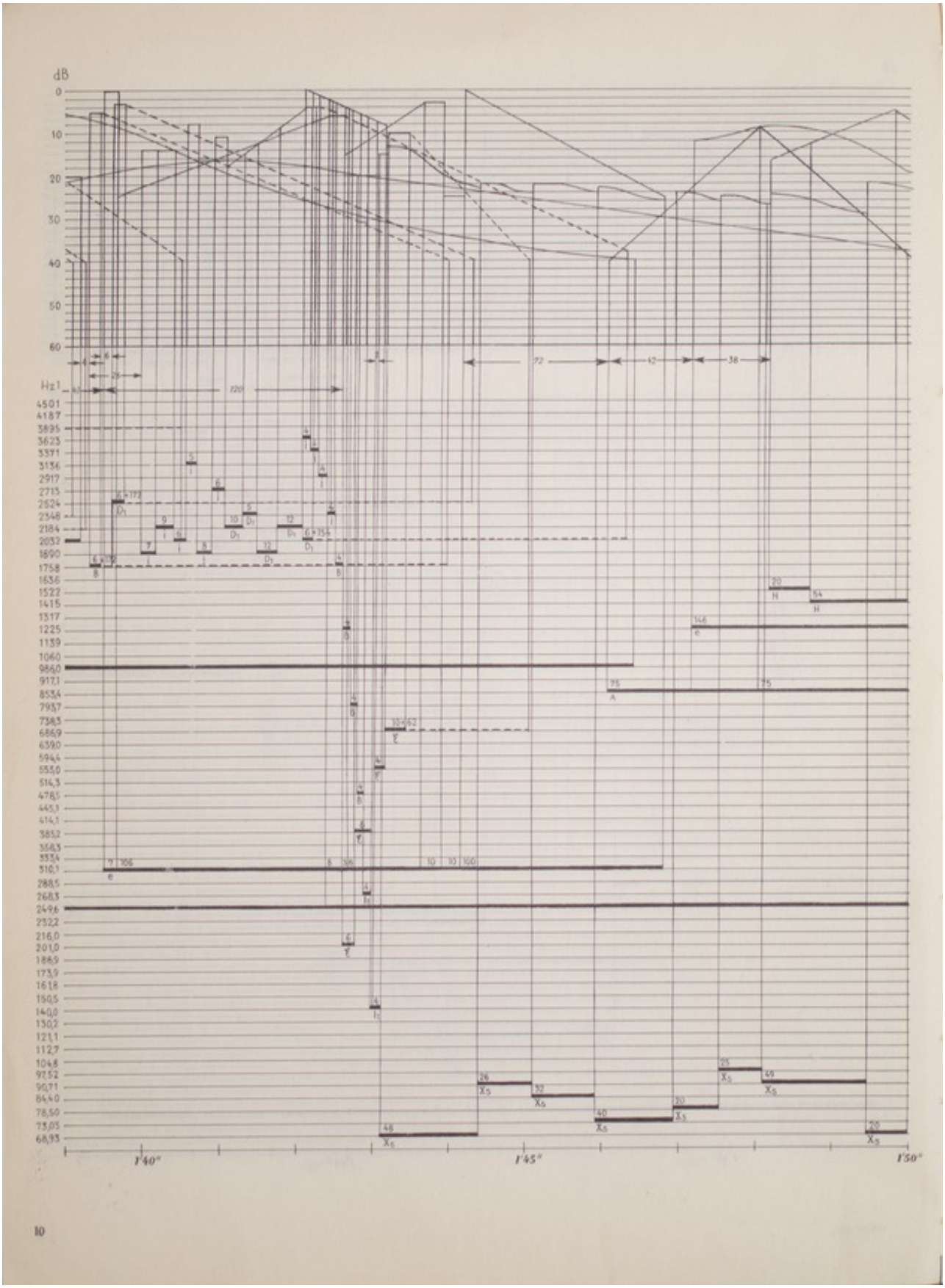

Figure 15 Andrzej Dobrowolski, Muzyka na Tasme Magnetofonowa nr 1 (Music for Magnetic Tape No.1), 1963. Published 1964. (Dobrowolski, 1963)

Research Phases

Drawing along

'*all clocks are clouds*– even the most cloudy of clouds'[27]

–Karl Popper, *Of Clouds and Clocks*

There is perhaps nothing more powerful than feeling in-sync with another being. That one is both individual, and part of an emergent whole. Whether it be through complex play, verbal communication or emotional expression, we seek activities that facilitate sharing. Music, art, dance and sport are just a few such activities that give us joy in the feeling of joining with one another, in a process of being in-time and in-place.

Let's zoom-out and consider music making at a distance. People come together, sometimes with tools, to perform a collective activity requiring bodily movement and communication. Verbal and nonverbal cues are given to guide that activity, to organize behaviours and synchronise action in such a way that feedback loops are created within a community of participants. An adaptive system or group intelligence

[27] (Popper, 1972) 210

emerges through intercommunication, with bodies reacting to virtual signals that guide the direction of the activity. Environmental information is assimilated into one's own movement, providing a basis for future action and sound production.

If we zoom-in, we would see that our own bodies are also a complex system of communicating parts. This body in not fixed, nor a 'fleshy substrate'[28] of the self, but rather a much more fluid, mutable entity. Our corporeality is crafted through dynamic relationships with the world and itself, extending beyond the human form through technology and complex tool use. Organic and inorganic bodies provide feedback, giving us signals for when we should eat, who we love, and how we should respond to threat. Oscillating bodies couple, giving rise to information which is then interpreted and assimilated into behaviours. Chains of causality are established through which meaning, thought and action emerge.

ENTRAINMENT

This coupling is commonly described as entrainment. Entrainment is when 'two rhythmic processes interact with each other in such a way that they adjust towards

[28] ibid.

and eventually 'lock in' to a common phase and/or periodicity.'[29] This occurs intra-individually (such as in the entrainment of networks of neuronal oscillators), inter-individually (co-ordinated action of individuals in a group), and amongst groups (when distinct groups co-ordinate action). It is a phenomenon shared by organic and inorganic systems, as demonstrated by the Dutch physicist Chistiaan Huygens' observation of the entrainment of suspended pendulum clocks,[30] the synchronised flashing of fireflies and the circulation of blood and hormones in our own bodies. Influence can either be symmetric; the intra-influencing of one another's actions, or asymmetric; when beings attune to a fixed thing that cannot be influenced.[31]

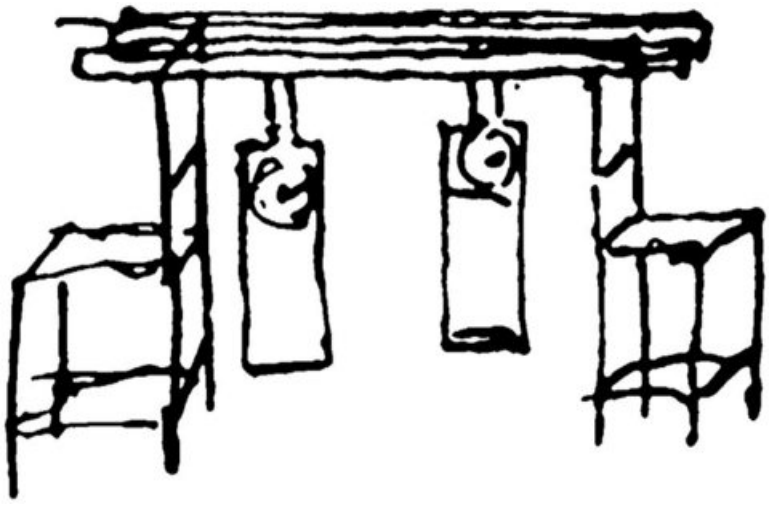

Figure 16 Christiann Huygens' drawing of the entrainment of pendulum clocks (Eindhoven University of Technology, 2016)

[29] (Clayton, Empirical musicology review., 7 (1-2).) 49
[30] (Cajori, Mar., 1929) 222
[31] (Clayton, Empirical musicology review., 7 (1-2).) 51

Total synchronicity is at one end of a dynamic spectrum of interconnectedness. We are, and exist within, a population of oscillators that are constantly in a process of phasing; falling in and out of sync with themselves, each other, and the environment. Circumscribing synchronicity is what makes bodies fallible, rather than impossible machines ticking away in perpetuity.

I started this portfolio by asking what type of rhythmic interactions can be found along this spectrum. At the time, I was looking to move away from discrete decision making towards finding materials that dictate their own formal handling. I was looking to join with materials and systems, rather than generating them from a subconscious library of prior influence hidden from my conscious creative thought. This was a deliberate act of limitation– a wrenching away from my prior practice toward sounds that I did not yet know. In the first phase of my portfolio, this (somewhat counter-intuitively) manifests in process works– highly systematized and architectonic in nature. I now consider these pieces to be a necessary initial step in the search for forms which are unveiled from within the fabric of sound materials.

507 MECHANICAL MOVEMENTS

The first piece included in this commentary is *507 Mechanical Movements*, performed by Ensemble Nikel at the Royal College of Music in November 2016.

Prior to composing *507,* I had written several pieces for ensembles and orchestras through competitive programs. My compositional process was often abstracted from sound itself, mainly working directly into notation while rarely producing acoustic sounds throughout the composition process. Miscalculations were made on the basis of not fully understanding how sounds behave when combined as a result. Moreover, I was interested in the extreme end of the entrainment continuum, with the hope that small modules of sound could be pieced together, block by block, to create a dense grid-like patchwork of interconnected cells that would interlock precisely to produce an emergent whole. I tried with and without conductor, metering in subdivisions, longer units and not metering at all, but nothing was really working. I was not reaching the level of unity or synchronicity that I was searching for. Nonetheless, I felt that with a more direct engagement with sound and a collaborative rehearsal ethos, I could achieve the type of unified and highly synchronised texture that I was after. I decided to give it one last go.

Nikel came to the RCM with great energy; a band ethic and emerging repertoire, whose instrumentation required exploration and collaboration prior to rehearsal. I remember distinctly the exchanges with Yaron Deutsch, the group's guitarist and founding member, prior to rehearsal. We would send samples backwards and forwards, searching for instrumental actions that would produce the sound qualities that I was looking for. I tested and recorded all of the sounds heard throughout the piece prior to rehearsal and arrived optimistic that this work would engender a more positive performance experience.

In *507*, I approached the ensemble as a meta-mechanism through which I could explore unified ensemble identity. I used algorithmic modules, stratified and recombined through time, to create sonic continua which undergo processes of segmentation, insertion and decay. The grid is clearly audible in the piece, with a periodic pulse providing a framework through which lines of sound travel, with global tempo markings and inserted periods breaking up the regularity of the flow. The sound palette of the piece is by-and-large noisy, informed by both the corporeal and instrumental mechanisms required to produce sound, and the sound profile of machinery and industry. I play with the perception of these sounds through repetition- exploring micro-transformations on both a temporal and timbral level.

My work began from gathering and listening; searching for instrumental sounds that have an energetic profile comparable to those of industrial machines. I used the British Library sound archive as a resource for site specific industrial recordings, compiling field recordings of turbines and generators. I was left with a sound corpus; a database of sounds gathered from a variety of resources that spoke to each other on both a spectromorphological and conceptual level. I began by freely combining these sounds, searching for compound sounds which were the by-product of energy loss within a mechanized whole. I focused on air and friction-based sounds that had an unstable and high-pressured internal energy, a timbral quality which was present throughout much of the sonic corpus that I had collected. These were then distributed amongst the ensemble using bell-ringing methods; simple algorithms that recursively rotate integers to create a great variety of possible combinations (fig. 17).[32]

[32] (http://www.ringbell.co.uk/methods/pb5.htm, 2019)

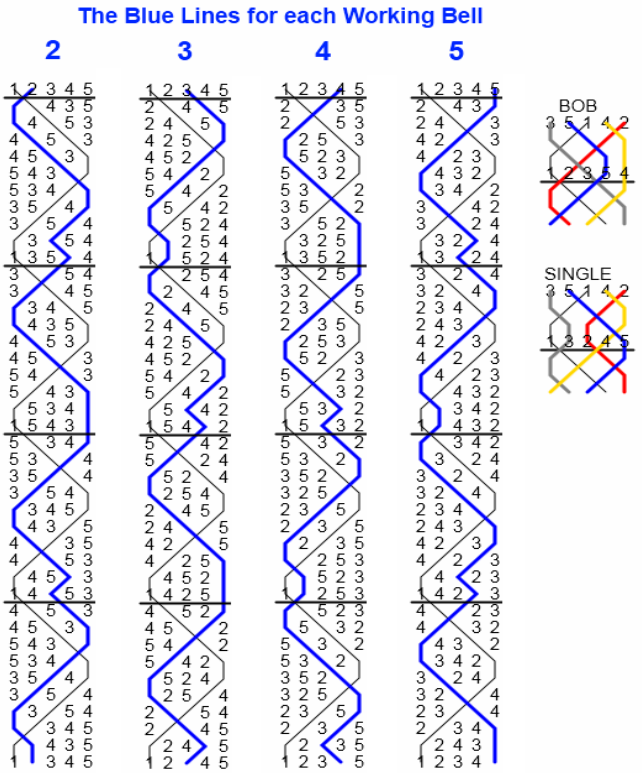

Figure 17 *Plain Bob Doubles* Ringing Method (ringbell.co.uk, n.d.)

For the first section of the piece, I assigned each number of the method to an action or a silence. I then assigned each instrument a number of these algorithms as demonstrated by the percussion in fig. 18:

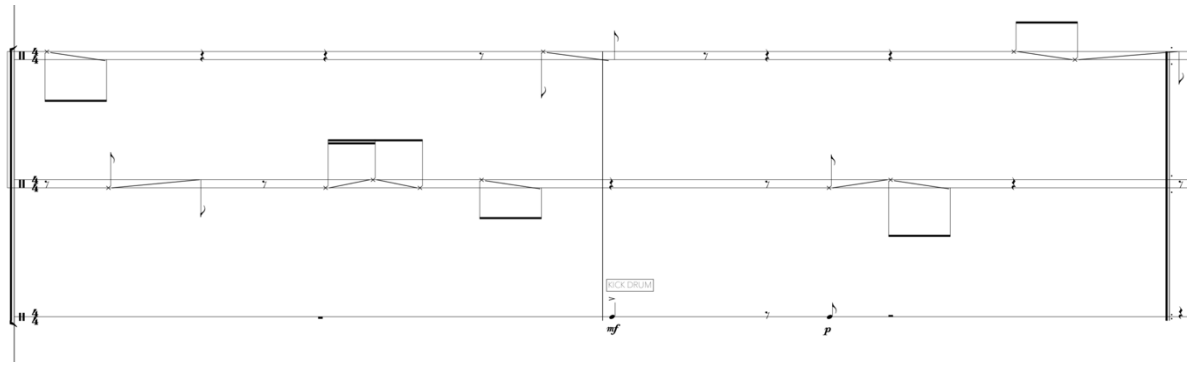

Figure 18 *507 Mechanical Movements, perc. b. 9–11*

Each hand is given its own stave, with brush strokes toward and away from the performer being assigned a rhythmic pattern from the algorithm. A third algorithm is assigned to the foot of the performer (in this case the bass drum). The piece begins with each instrument of the ensemble following a distinct path through their algorithms. Following a number of collective repeats, the ensemble splits into individual modules that maintain an even pulse. This material continues on its predefined path, before globally slowing to the point at which clearly defined periodicity disappears.

In the second section, I created compound sounds across the instrumental body of the ensemble, with pitched and noisy elements being equally weighted. I assigned to the saxophone and piano a combination of non-pitched sounds, individual pitches and multiple sounds (multiphonics), with the guitar rarely producing a stable tone. The complementarity of the sound corpus means that no sonic hierarchy is established; the instruments melt into a unified and constantly shifting energetic mass. As the material progressed, I felt that there was an implicit energy in this that demanded a more tactile approach, and through intuitive additions and subtractions a rhythmic cell was formed. This is then recursively cut-up and re-inserted with modules that are derived from the same material. In section three, the ensemble re-energizes, with material not dissimilar to the start being introduced, although the

temporal entrainment held between the instruments is weaker. Finally, the texture erupts into fragmented ascending lines, interpolated with material from earlier moments in the piece. These materials are presented in a much more concentrated fashion, before finally splitting apart again.

Formally, I view *507* as an exploration of causality, with repetition being used as a tool to weigh difference. I use machinic compositional strategies, such as insertion and cutting, to disrupt a reiterative form, with an action based and choreographic approach to instrumental writing highlighting the materiality of the bodies present. The vocabulary of the piece is the result of an asymmetric entrainment to the industrial field recordings and the algorithmic distribution of these sounds via the bell-ringing methods. The performers are asked to synchronise action and to work within the periodicity of the grid in a precise fashion, whilst also listening to each other to find timbral and dynamic balance. Compositionally, my role was mainly in the sourcing of algorithms to create a recursive texture, finding sounds that could exist together within a unified body, and intuiting when to intervene and/or abandon the process.

GRAIN OF THE VOICE

Following on from *507*, I wanted to explore ways in which a dynamic feedback system could be created. I wanted to create a fluid, mutable and emergent form. Having been asked to give a lecture-recital at the Collisions Festival 2016, hosted by the Royal Central School of Speech and Drama, I decided to create a new work which would explore these themes. It is included here as a 'concept' score, with a representative performance yet to be given.

Grain of the Voice, composed for amplified vocal sextet, feedback system and electronics, is not made of sound structures but rather a dynamic system of composed interactions. The title is drawn from Roland Barthes' widely cited essay of the same name, found in *Image, Music, Text.*[33] In my reading of the essay, Barthes' 'grain' is fundamentally an awareness of the material qualities of the voice when singing text. As I was looking for a way of revealing the materiality of the performer's body in this work, I decided to use the voice as the sole acoustic sound source. Rather than exploring this in relation to text (as in Barthes), I decided to

[33] (Barthes, 1977)

focus solely on the timbral and morphological qualities of the voice, abstracted from text and specific meaning.

Drawing upon Stockhausen's Intuitive music,[34] Agostino Di Scipio's *Systema Ecologica*,[35] Alvin Lucier's *I am Sitting in a Room*[36] and Dieter Schnebel's *Maulwerke*,[37] *Grain of the Voice* outlines a possibility space for the performers to act within. Music emerges as the audible trace of vocal behaviours, with the structural coupling of machine, human and environment giving rise to an exploration of the related technologies of the voice. Self-referential systems shape ensemble interaction, with the 'environmental' condition auto-poetically organizing. To create these interactions, I needed to enable communication across a variety of bodies and components; from the inter-environmental (voices+ electronics+ acoustics), the inter-personal (social/personal interactions), the inter-local (between components of the voice), the intra-local (between constituents that make up a particular system), and the intra-constituent (different oscillatory patterns within a component).

[34] (Bergstrøm-Nielsen, 2006)
[35] (Scipio, n.d.)
[36] (Lucier, 1981)
[37] (Schnebel, n.d.)

To achieve this, I began by researching dynamic organic systems and investigating the mechanisms and technologies of the human voice. Initially, I explored various biotic systems characterized by a capacity for self-organization. As demonstrated by Robert Ulanowicz (1997) and Jesper Hoffmeyer (2008),[38] the shifting components of auto-catalytic sets are extremely elegant examples of this (fig. 19). For example, the water plant bladderwort (*Utricularia floridiana*) draws matter and energy into its system and changes and adapts accordingly. A causal chain is established in which energy flows from component to component, resulting in an increase of energy and growth of the whole system. I decided to adapt this system as a means of modelling the interactions in space, with the result being a causal chain of interpersonal interactions.

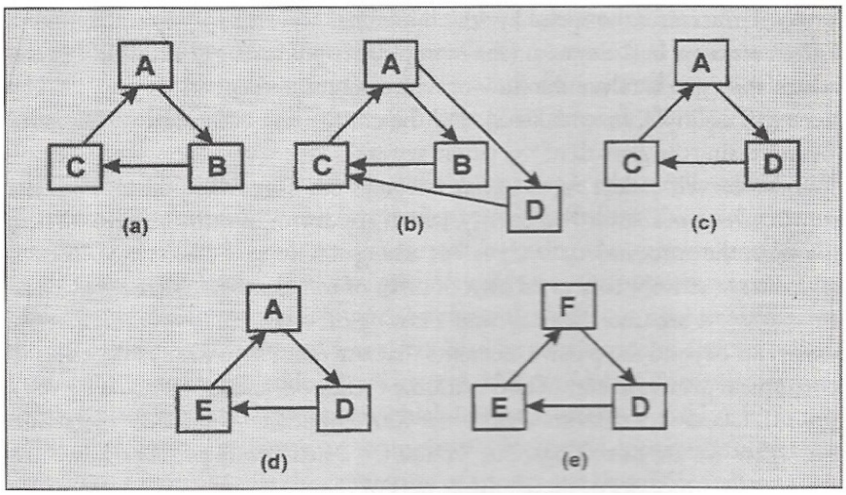

Figure 19 Representation of auto-catalytyic set
showing the step by step shifting of components, rep. (Hoffmeyer, pg. 50)

[38] J. Hoffmeyer, *Biosemiotics* (University of Scranton Press, 2008) Diagram reproduced from pg. 50

I represented this through a series of graphically notated tableaux, with particular bodies interacting in particular ways. Fig. 20 shows part of the full score:

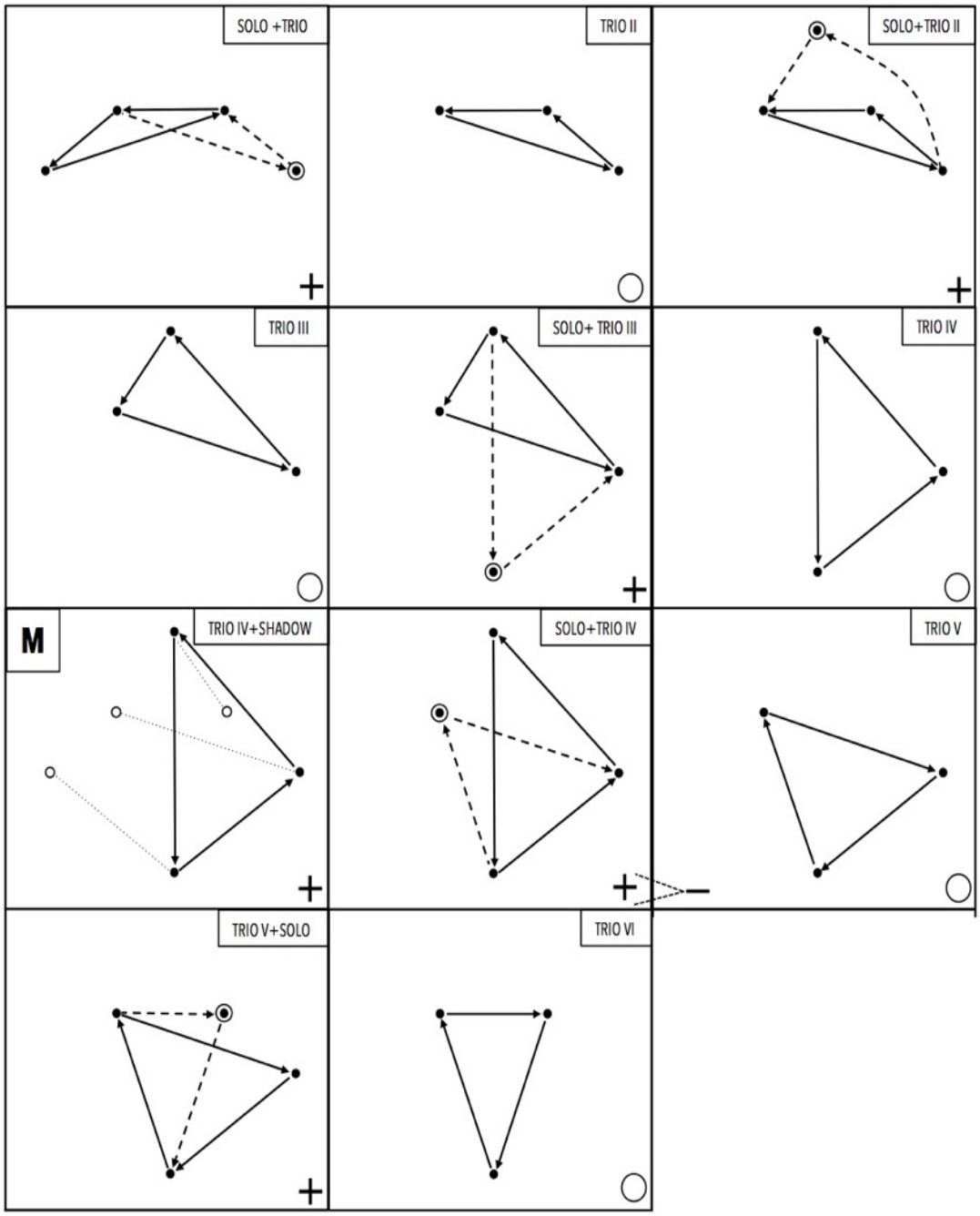

Figure 20 interaction score, *Grain of the Voice*

Each point in the diagram represents a vocalist. The series establishes a pattern of sound passing from performer to performer. The energetic flow of the piece is determined by the plus and minus signs in the corner of each square,[39] with the global system's energy increasing or decreasing through an awareness of local activity. Through a series of permutations (mirroring, rotation), I use this potentially endless spatial modification chain to situate the performers in space, time, and in relation to each other.

Having established a model to formalize the interactions, I then turned to finding a means of representing the activity of the constituent components. As demonstrated by L. Glass and M. Mackey in *From Clocks to Chaos* (1988), physiological rhythms are generated through a great variety of somatic mechanisms that result in oscillations.[40] I therefore determined to create a notational system that could represent oscillation curves, stable states, and fluctuation.

[39] A notational strategy borrowed from Stockhausen

[40] L. Glass and M. Mackey, *From Clocks to Chaos: The Rhythms of Life* (Princeton University Press 1988) pg.67

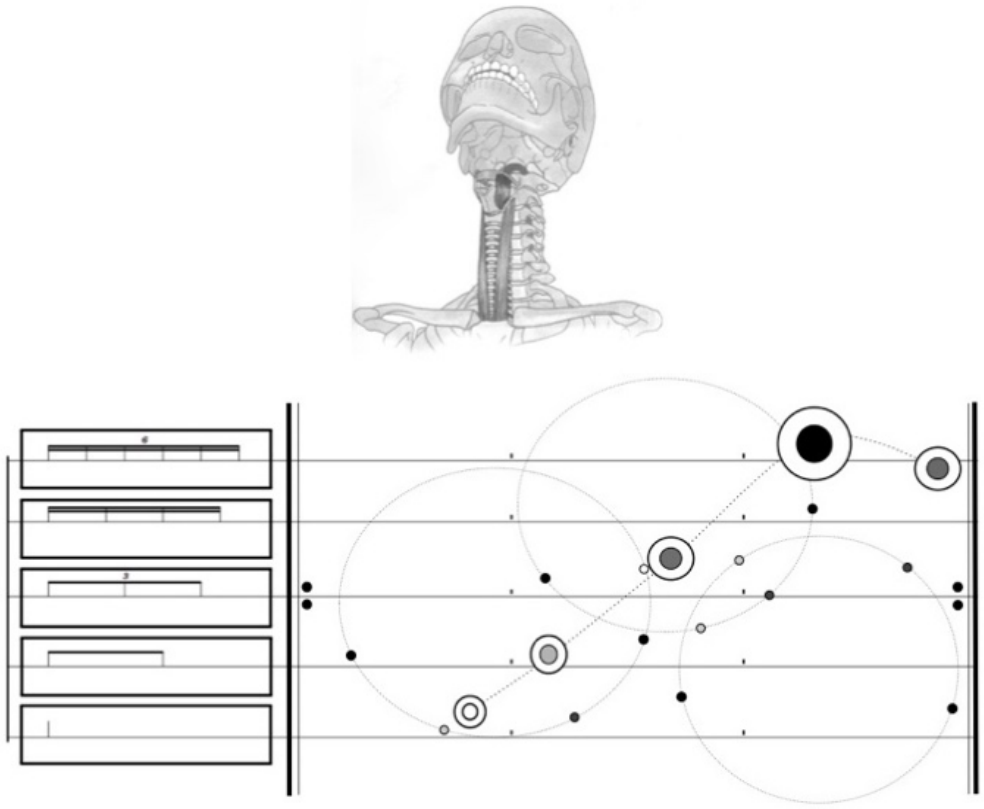

Figure 21 Oscillatory system, *Grain of the Voice*

In fig. 21, a stave is shown in which oscillation pattern and speed is represented on the vertical axis, with time on the horizontal. In this instance, differently sized points and dots mark sonic events at different levels of intensity. The placements of these events are governed by the global interaction model and a series of morphological/temporal changes. When a new component (marked in the above by a circle within a circle) enters, it impacts the onset, dynamic or continuant of the chosen sound (or a combination of these), thus gradually altering the nature of the sounding events over the course of the piece (fig. 22).

Tableaux	Onset	Dynamic	Continuant
15	Short	Quiet	Prolonged looping rotation
16	Short	Ascending activity (C)	Prolonged looping rotation
17	Short	Ascending Activity (C)	Swirling (C)
18	Short	Ascending	Echoic Looping (C)
19	Short	Rising sequence (C)	Echoic looping
20	Short-Long (C)	Cascades (C)	Echoic looping

Figure 22 morphing causal chains, *Grain of the Voice*

Following this, I researched the anatomy of the voice as a means of understanding how its constituent components produce such a great variety of sounds. Using Blandine Calais-Germain and François Germain's *Anatomy of the Voice* as a primary resource,[41] I began to explore how the particular systems of the voice (e.g. the air pressure system, vibratory system, resonating system) are used to create sounds. For example, one can physically feel and hear the adduction and vibration of the larynx through producing a chain of consonants that move from *fffff-vvvvv*, or one can listen to the tightening of the glottis through the emission of very high sounds. I therefore decided to deconstruct the voice and encouraged the performers to explore the great variety of vocal sounds at their disposal through the coupling of vocal filtration systems. I was not interested in being confined to the traditionally

[41] (Blandine Calais-Germain, 2016)

musical– it was my intention to create materials that go beyond normative musical syntax and are more closely aligned to gameplay or warm-up exercises. To encourage the production of these sounds, I created a vocal interface (fig. 23), with moving dials to help performers explore vocal sounds not traditionally associated with their instrument.

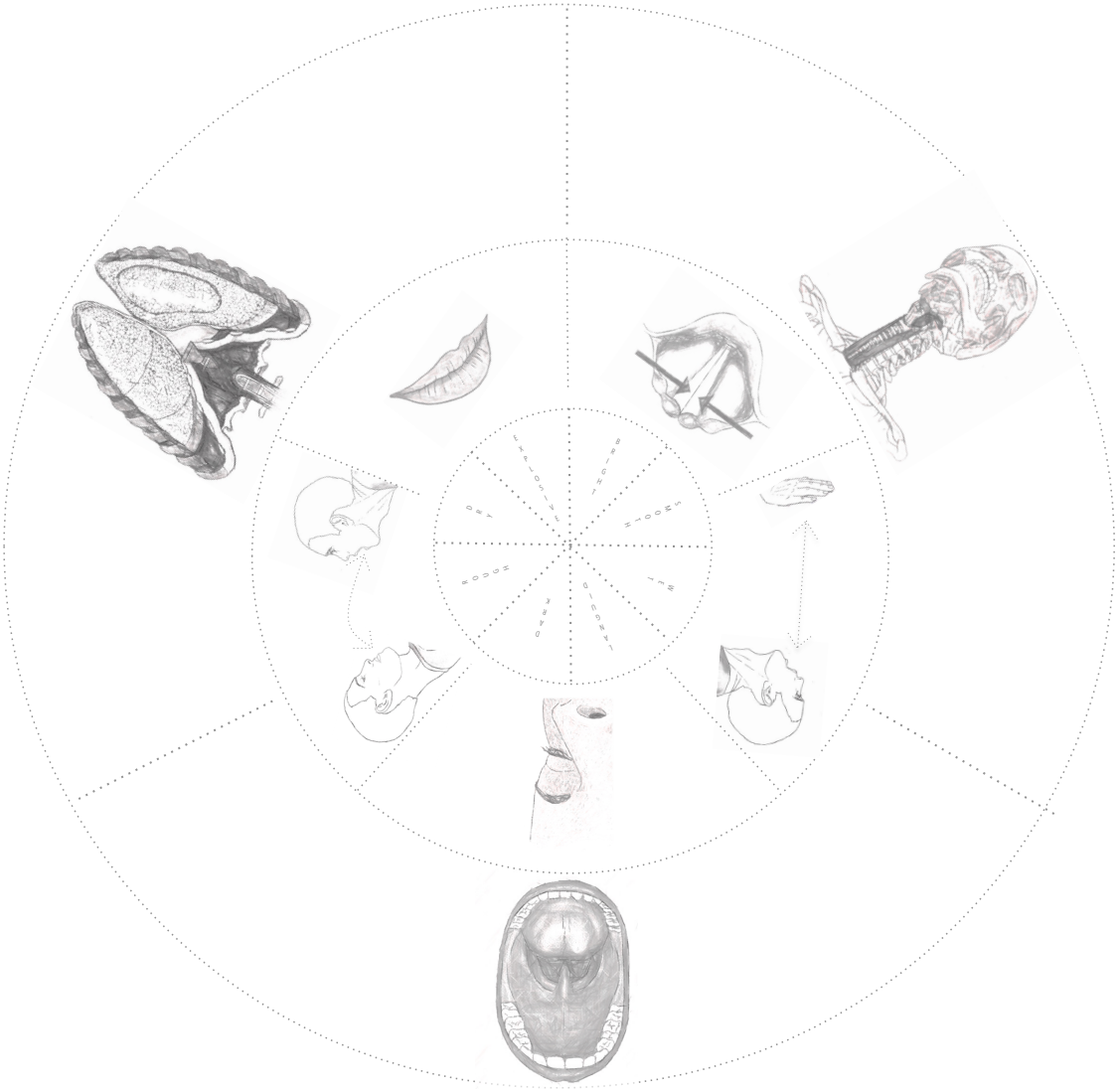

Figure 23 vocal interface, *Grain of the Voice*

The outside dial represents the three core systems of vocal production: the air pressure system (lungs, diaphragm, ribs), the vibratory system (larynx, glottis, vocal folds) and the resonating system (pharynx, oral cavity, nasal cavity). These are then filtered by a secondary system represented by the middle dial– the lips, the hand, and the nose. Finally, a series of descriptive words are included as a means of encouraging timbral variety. The performers are asked to collectively decide on choice of sound and can use this interface at will. As a result, I consider the piece to be a form of distributed creativity– a situation simultaneously controlled and dynamic that rejects the notion of a central compositional figure.

Finally, I created a dynamic loop through a feedback system using the input from the amplification of the voices and the speakers. The shape of the room, performers and audience all impact and effect the sonic quality of the piece. A range of filters, delays, and reverbs can be used to alter our virtual perception of spatial dimension. The electronic performer is there to listen, respond, interfere and animate the performers, finding methods and means suitable to the occasion. They shape the growth patterns of the sonic ecology through dynamic control and variation, with periods of growth, development, maturation and senescence governing the overall shape of the piece.

The result of all of the above is an assemblage of materials that may (or may not) be used in performance. These are meant to promote interaction, encourage performative freedom, distribute creativity and help in exploring the technics of the body.

I had learnt a number of things from writing *507* and *The Grain of the Voice*.

Firstly, that I could navigate selectively gathered corpora of sounds to produce results which are larger than the sum of their parts. Chains of sound can be woven together to produce complex results, particularly when components share a conceptual or sonic root. In the case of *507*, the aim was to allude to the initial stimulus (an industrial field recording), in *Grain of the Voice,* to produce a new organisational model.

Secondly, I learned that slowly morphing sonic continua produce forms which are not reliant on local gesturation, but rather the perception of micro-transformation through time. If one was to take a snapshot of that process, the wave-like accumulation of transformation would be lost. Whilst the sound surface of each instance must be compelling, gestures are part of larger processes of timbral change which reveal themselves over the course of the piece.

Lastly, I learned that I wanted to move beyond ergonomic notational platforms to score my work. This was for a number of reasons. Working closely with sound in *507* had taught me the importance of engaging haptically with the materials in play. My interest in the morphology of sound did not flatten easily to ready-made and all-purpose symbols, and so I began to create my own graphic vocabulary to convey my experience of these in *Grain of the Voice*. I wanted to communicate information in such a way that the agency of the performer was much more present in the sound of the work, and that notational tradition would be used as one possible strategy, amongst others, to achieve the intended result. I also wanted to slow my typesetting process down so that every sound had been considered from a number of different angles. Whilst speedy annotation can help in capturing the essence of an idea, I found that working directly onto the page encouraged me to populate the score surface with redundant compositional decisions. I'd enjoyed the process of finding notational solutions for complex and evolving sounds in *Grain of the Voice* and wanted to continue to find a more personal approach to notation moving forward.

LIFE OF LINES II

In the winter of 2017, I was invited by the United Instruments of Lucilin to participate in the Luxembourg Composers Academy, mentored by Chaya Czernowin and Mauro Lanza. This resulted in the creation of a short piece premiered at Rainy Days Festival 2017. This initial piece was subsequently revised and commissioned by Huddersfield Contemporary Music Festival 2018.

Life of Lines II is a study into sound as an expression of time. The piece takes the form of a braid, in which threads of sounds delicately enlace over time. In contrast to the rigid and quantized patterning of *507*, I wanted to create a situation in which slowly evolving sonic continua make space for sonic qualities to emerge over time. Further to this, I wanted to work with a more refined harmonic and timbral palette which convey both a sense of directionality and a rich moment-by-moment experiencing of sound events.

In the initial research phase for the piece, I explored the precedent for work in which the vertical alignment of sonic events is negated in favour of blurred and stratified temporalities. This led me to the formal thinking of Bryn Harrison and by extension,

Brian Ferneyhough, Morton Feldman and Aldo Clementi.[42] These composers share a particular approach– the weaving of sonic streams together to form complex textural aggregates in which the demarcation of time is not clearly audible. Harrison's *Repetitions in Extended Time* made a particularly strong impression (fig. 24).[43] To my ear, the piece's highly dense, cyclical and recursive iterations result in a kaleidoscopic shifting of perspective, in which the listener's attention to the sonic aggregate fluctuates as the piece (r)evolves.

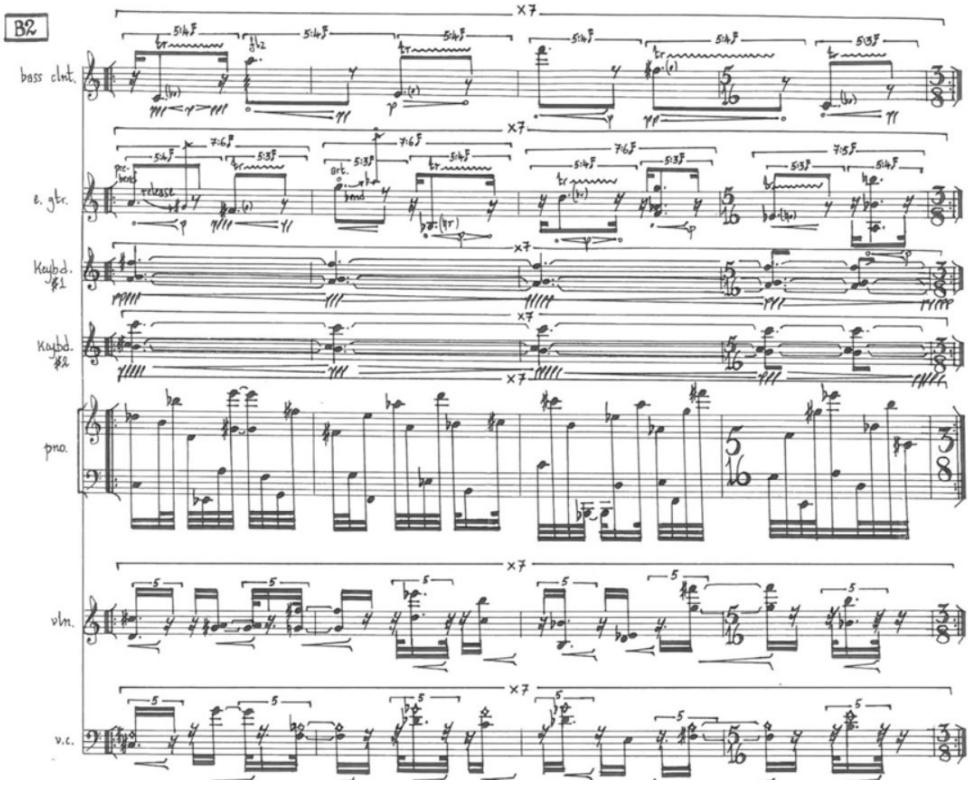

Figure 24 Bryn Harrison's *Repetitions in Extended Time* (Harrison, Repetitons in Extended Time, 2015)

[42] Bryn Harrison– Cyclical Structures and the Organisation of Time (Harrison, Cyclical Structures and the Organisation of Time, June 2007)

[43] (Harrison, 2008)

Clementi's *Madrigale* was also of great importance to me, with its singular entropic process both conveying a sense of formal inevitability and revealing the way in which our perception shifts from aggregate to event through the slowing of material. [44] Lastly, Feldman's *Piano and String Quartet* demonstrated to me how a reduced and self-similar set of materials could be recombined over an extended period to disassociate the listener from clock time. [45] This moves one into a sonic environment in which time becomes space; an expansive and irreducible entity that moulds our perception according to the distance between events. [46]

Through studying the above, I came to the view that moving beyond the clear demarcation of time required a rigorous controlling of event placement. I would be able to avoid vertical alignment (unless desirable) and regulate the growth and decay patterns of each sound-line. Ferneyhough's essay 'The Tactility of Time' provided a rationale for this type of work.[47] He describes how a limited number of musical events can be subjugated to processes of expansion and contraction within units of differing sizes. What results is an external clock which is either supported or subverted by the density of events within each unit. When taken in combination

44 (Clementi A. , 1979)
45 (Feldman, 1998)
46 (Feldman, 1998)
47 (Ferneyhough, Winter 1993)

with my experience of the Harrison, Clementi and Feldman, I had arrived at a methodology that would produce the type of asynchronous and unfolding continua which I was hoping to achieve. This thinking was utilised in *Life of Lines II* to create a densely populated network of events, with each sound thought of as a node within a rippling and asynchronous net of instrumental action. As the periods between each node shorten, the net tightens to produce a sense of inter-instrumental connection and tension.

There are several points of differentiation with the work of all of the composers mentioned above and *Life of Lines II.* Firstly, I wanted to subvert the rationality of the underlying process to create a situation in which both my hand, and the hands of the performers, intervene directly in the formal field. This meant subjecting these processes to liveness and to human error, from the compositional phase all the way through to performance. This process required multiple stages of formulation and intervention.

I began *Life of Lines II* by creating panels of predetermined lengths which were then divided into proportions. As shown in fig. 25, a global unit of 42 was initially divided into 11 measure of decreasing lengths. These measures acted as an external clock:

Panel 2		42									
Top	7	7	6	6	4	4	3	3	1	1	42
Numerator	8	8	8	8	8	8	8	8	8	4	
Percussion											
Stream A											
time	7	7	6	6	4	4	3	3	2		42
pulse rate	14	14	11	10	6	7	6	5	3		
L.C.D	14	14	12	12	8	8	6	6	4		
density rate	1	1	0.916667	0.833333	0.75	0.875	1	0.833333	0.75		
Stream B											
time	1	1	3	3	4	4	6	6	7	7	42
pulse rate	1	1	4	5	6	5	7	8	10	11	
L.C.D	2	2	6	8	8	8	12	12	14	14	
density rate	0.5	0.5	0.666667	0.625	0.75	0.625	0.583333	0.666667	0.714286	0.785714	
Stream C											
time	4	4	6	3	6	3	7	1	7	1	42
pulse rate	4	5	8	3	7	4	10	1.5	9	1	
L.C.D	8	8	12	6	12	6	14	2	14	2	
density rate	0.5	0.625	0.666667	0.5	0.583333	0.666667	0.714286	0.75	0.642857	0.5	

Figure 25 *Life of Lines II* temporal proportions, panel 2

I then subdivided each proportional unit to give a lowest common denominator (L.C.D). I then divided the pulse rate against the L.C.D to give a density rate, which is equivalent to the relative speed of events within the given proportional unit. In the above, taken from the percussion part of *Life of Lines II* at rehearsal marking 2, a string of proportional units proceeds forwards, backwards and outwards. I then used a short numeric sequence derived from the bell ringing methods in *507* to decide where, and what type of, sounds should be placed in time, creating a rich network of possible event placements. Compositional decisions were made intuitively about the density rate, depending on the temporal effect intended. In this instance, three lines of material in the percussion part create a temporal weave that grows and decays throughout the panel as demonstrated below:

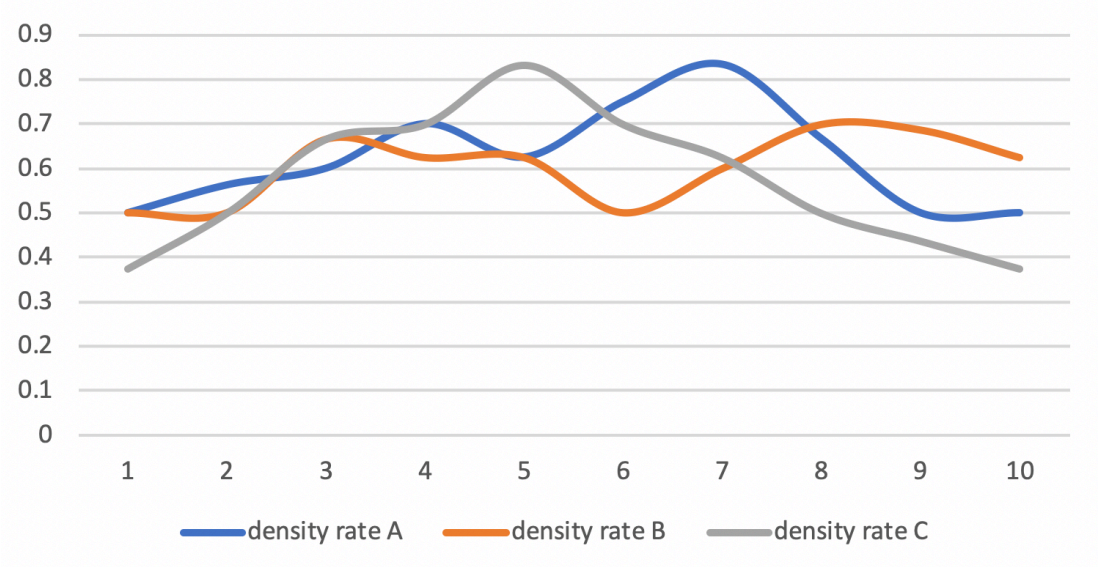

Figure 26 *Life of Lines II* percussion density rate, panel 2

As can be seen in fig.26, the apices of the curves rarely coincide. When aggregated, they form a contrapuntal web of evental possibility, with sonic attacks becoming nodes along an inaudible temporal string.

This abstract process was then simulated through computer software. I 'performed' the placement of sounds, creating a timecode which was given within 0.1 seconds of my action. Inevitably, my performance was inaccurate. The rationality of the process met my hand and was redirected according to my accuracy. When I was happy with the result, the timecode was 'stamped' in the score. This then underwent processes of intuitive revision and erasure. Left was an incomplete map of points which obfuscated the process. New points of contact emerged out of this process– aggregates or gestures which were articulated according to my feeling out of the material and my understanding of the instrument at hand. Often, multiple passes

were made at the erasure stage of the process, as each erased event opened up further paths of discovery, leading to greatly varied results with each compositional decision.

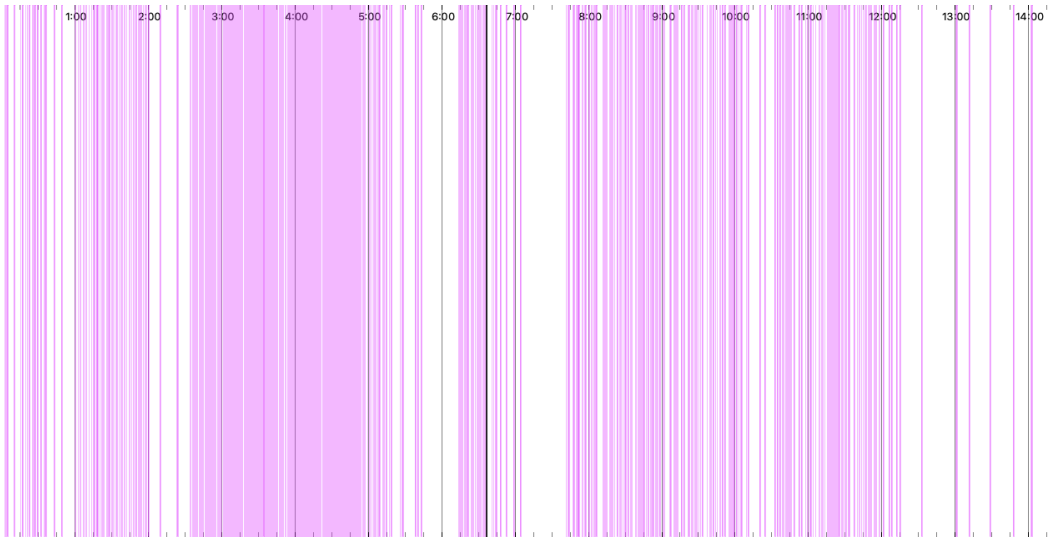

Figure 27 *Life of Lines II*, visualisation of onset instants through time

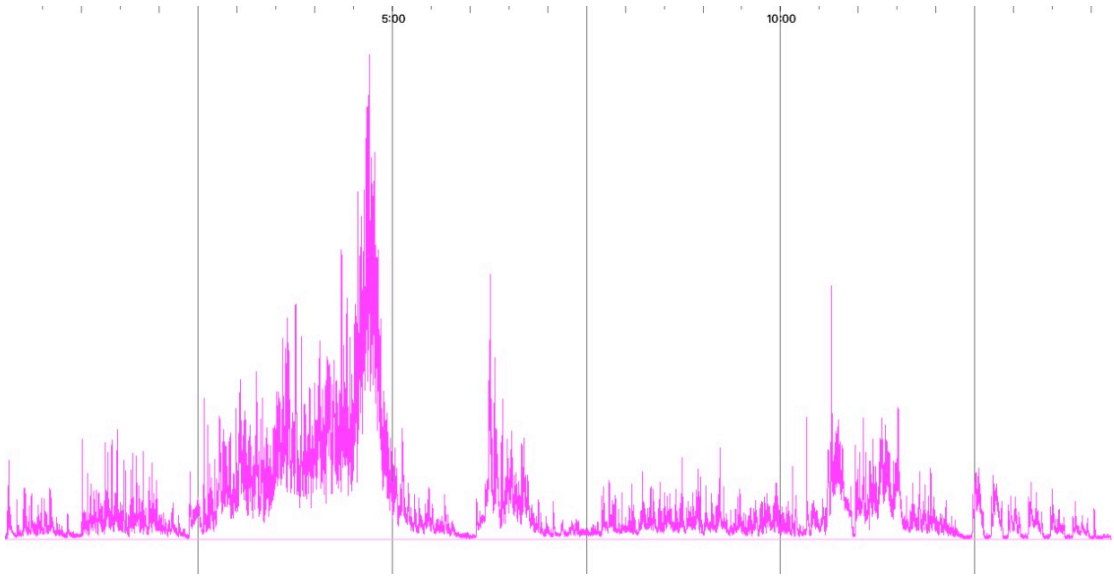

Figure 28 *Life of Lines II*, intensity plot through time

The score uses space-time notation as a means of the performers further intervening in the process. Whilst I specifically plotted the placement of each individual event, the performers were asked to judge this within longer units of time (a second) and without strict ratios (tuplets) to help guide their action. Furthermore, there are external temporal indications (accelerandi and ritardandi) that make precise placement all the more difficult. What results is a field of action in which the acceptable outer bounds of event placement at any given time are outlined, while directly implicating the agency of the performer in the work. This is contra to the prescriptive notational strategies utilised by Harrison and Ferneyhough to delineate temporal strata not dissimilar to that heard in *Life of Lines II*.

Feldman's graph notation, particularly in the *Projections* series (fig. 29) and *King of Denmark* provided a precedent for the graphic vocabulary used in *Life of Lines II*. In this notation, performative intention and intervention are of equally importance to the compositional working. In Feldman's lexicon, 'ictuses' are inaudible units of time and should be felt by the performer and pollinated by the sounds indicated.

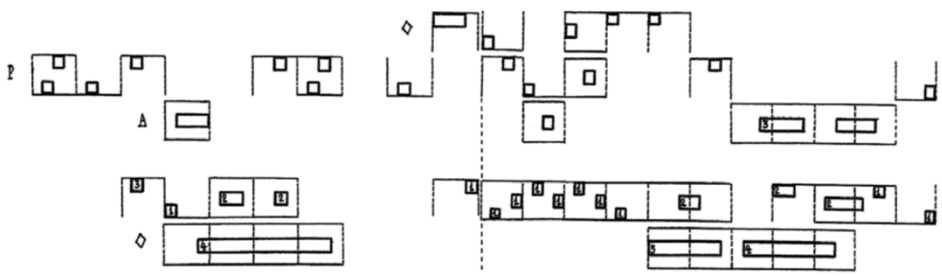

Figure 29 *Projection 4, Morton Feldman,* rep. pg. 155 (Cline, 2016)

The vertical placement of the sound indicates register, with the colour and/or number indicating sound quality. I took a similar approach in *Life of Lines II*, most notably in the percussion part. As can be seen in fig. 30, the percussionist is asked to source materials in three timbral groups; metal, skins and wood. Each timbral group is assigned a symbol, with the size indicating relative dynamic. The vertical axis corresponds to pitch and/or spectral density, and the horizontal axis distributes sound events through time. The continuation of the sound is indicated by an additional line; with a dotted line suggesting a continual and fast reiteration (tremolando) and a curved line indicating a modulation (pitch bend). In this example, I also indicate global temporal directions (accel. /rit.). In the piano part, I stratify and overlay classes of material, which gradually unfurl with the patterns produced by the percussionist. The result is a texture in which sound events are nodes along an invisible string, coalescing together to produce an emergent whole.

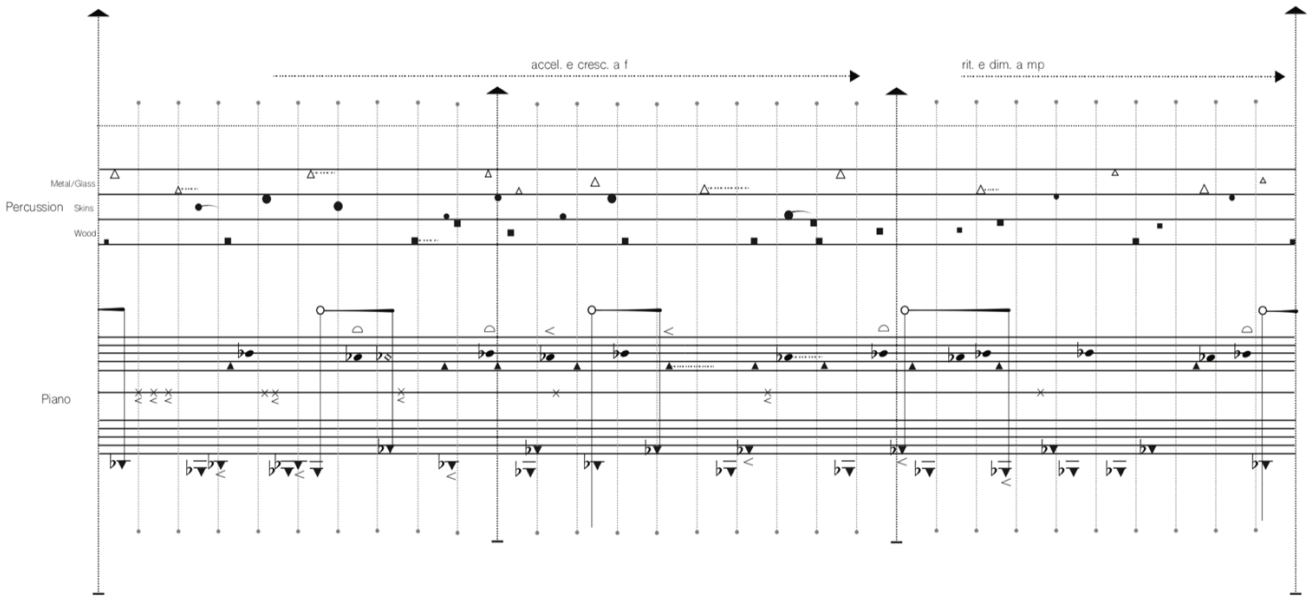

Figure 30 *Life of Lines II*, pg. 3

One of the attractions of Feldman's graph notation is the economy of means to produce complex and varied results. The openness of the notation leads to a set of differentiated performances which are unique to each instance. Furthermore, Feldman's willingness to combine compound parametric symbols (such as traditional notation), uni-parametric symbols (which articulate and produce simple sounds such as a percussive attack) and text and numeric instruction, opens up a world of possible communication models which move beyond the flatness of a traditionally notated score (fig.31). His approach was both exploratory on a compositional level and necessitates an open-ended engagement by performers, who must search for personal renderings of the material.

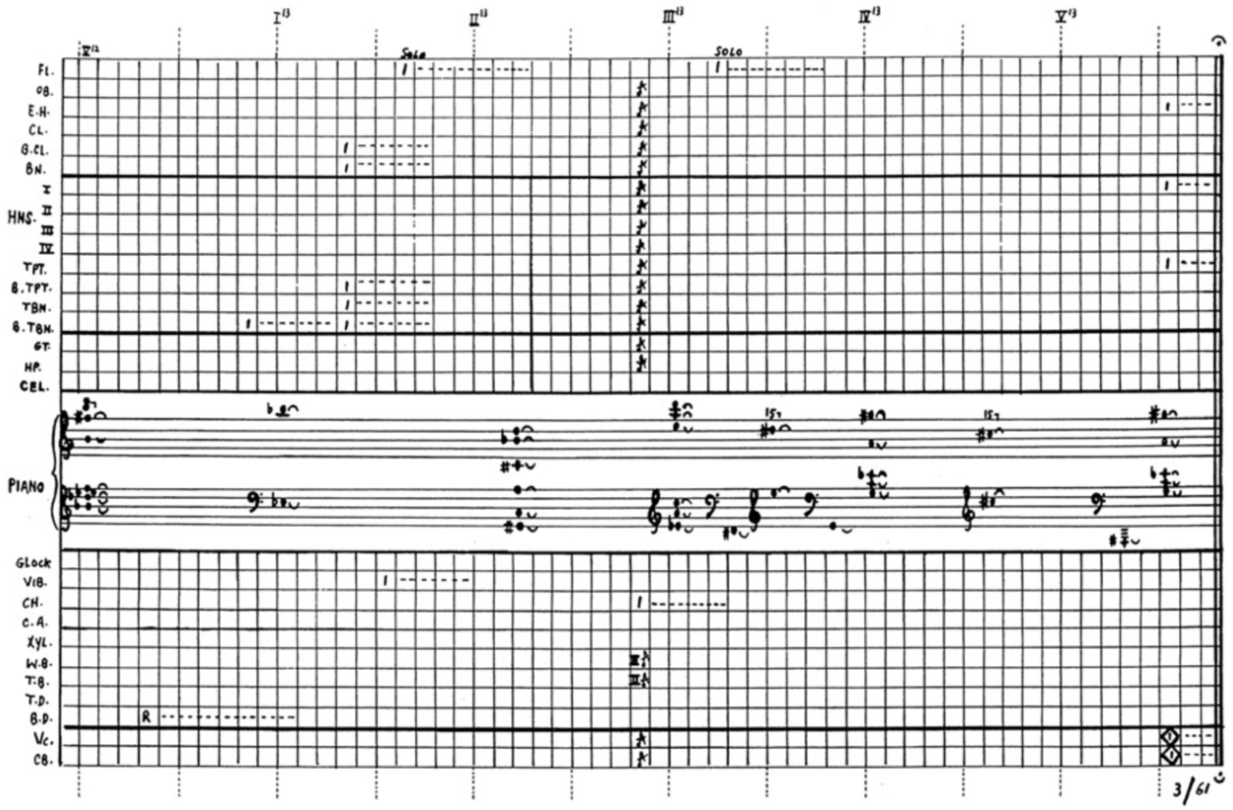

Figure 31 *Out of 'Last Pieces, pg. 12.* rep. pg.78 (Cline 2016)

On the surface, the Feldman-like giving over of compositionally controlled event placement and timbral decision making in favour of performative intuition can be viewed as counter-productive to the rigor of the underlying process of *Life of Lines II*. Whilst a liberal attitude to highly specific event placement may be implicit in the score surfaces of Harrison and Ferneyhough, performative subversion of the material becomes explicit and desirable in *Life of Lines II.* In my experience, the indication of performative agency results in an attitude which maximises listening, to both one's individual actions and the global result, and becomes a clear imperative to all those involved. The production and placement of events must be felt as much as read; heard in relation to itself and the events that surround it. Performers must become aware of how their actions shape the actions of others, and the impact this has on the perceptual strength of instrumental entrainment from moment-to-moment. Performer's judgement and dexterity are called upon to shape the piece beyond a mechanical rendering of a structure toward a more fluid and mutable situation in which inter-influence can be keenly felt. The composed form becomes by-and-large redundant as we move towards listening to the ensemble interplay and the quality of the sounds themselves. The performers, score and instruments all exert resistance, influence and forces of their own, on the material seen on the page.

A further point of difference can be found in the treatment of harmony and timbre. As Harrison describes, he uses step-wise pitch structures to allude key centres, making harmonic directionality redundant in favour of cyclical and recursive panels of sound that float in a state between stasis and motion.[48] Moreover, timbral differentiation is negated in favour of homogenous textural surfaces in which little difference can be heard from one moment to the next.[49] In combination with the low-level dynamics of his work, instruments melt in and out of one another's sound, creating an amorphous global texture.

Whilst I am greatly drawn to the viscous textures heard throughout Harrison's work, I employ a somewhat different harmonic framing in *Life of Lines II*. A quasi-spectral approach to harmony is used throughout, centring around an engagement with the material qualities of a single sound, the 7^{th} harmonic of a low B^{b} on the piano. I wanted to work from within the world of that harmonic, with the piece beginning with lines of sound projecting out of a harmonic region derived from the acoustic qualities of this source. As the piece develops, sounds coalesce and resonate together whilst gradually drifting to regions in which the harmonic function of the initial piano harmonic becomes increasingly peripheral. Whilst I maintained the low-

[48] (Harrison, Cyclical Structures and the Organisation of Time, June 2007) 17
[49] (Harrison, Cyclical Structures and the Organisation of Time, June 2007) 32

level dynamic heard in Harrison's work in *Life of Lines II*, the harmonicity of the piece creates a greater sense of directionality.

Lastly, I included timbral elements from outside of the 'syntax' of the abstract harmonic and instrumental world initially heard. For example, I asked performers to use their voice as a means of unveiling the identity of the performers behind the instrumental bodies and create a multidimensional view of the sound producing body. In the section between rehearsal markings 8 and 9, a more clearly varied collection of sounds is employed (music boxes, string preparation, crotales), resulting in distinct panels of sound in which differing attitudes to timbral synthesis and syntax can be heard. Lastly, I intersperse moments of verticality (synchronous chords) throughout the piece. I view these as the vertical stacking of elements that stands in relief to the linearity of the processes heard on either side.

Life of Lines II represented a significant step forward in my practice. I had arrived at a compositional methodology with which I could explore the spectrum of temporal connection; from total synchronicity in which a metric grid is clearly audible, to a much looser constellation of points in which the sense of clock time collapses. The

overlaying of temporal strata had created a global result in which synchronicity was no longer metrically articulated but rather in-phase, with instruments falling in and out of sync with one another and circumscribing an inaudible, shifting grid. Form, harmonic movement and gesture emerge out of the confluence of algorithmic growth patterns, with intuitive compositional decisions (erasures) and performative action explicitly intervening into the formal field. Mixed notational strategies were used to create a chart which displays a degree of openness, leading to distinct performative results with each rendering (fig. 32).

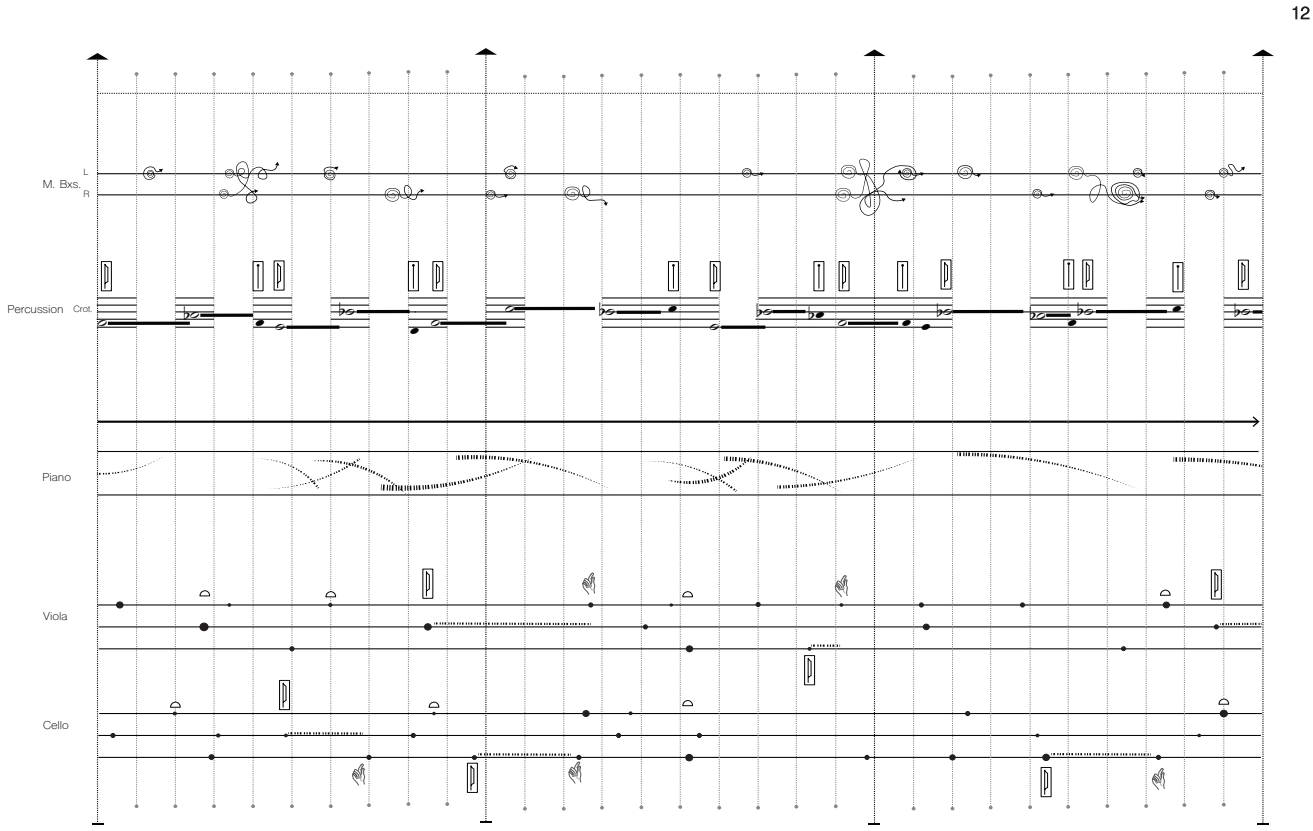

Figure 32 *Life of Lines II*, pg. 12

OUR HEADS ARE ROUND, SO OUR THOUGHTS CAN CHANGE DIRECTION

'Composing music amounts to laying a series of points on a line'[50]

–Iannis Xenakis

Following *Life of Lines* II, I wanted to test the methodology I had arrived at further. Whilst I had found means of unveiling hidden lines and gestural constellations through the reduction and erasure of multiple informational threads, I had not fully explored the role that relational tempi play in our perception of this material. I also wanted to explore how archetypal (but ultimately inert) architectonic structures are subverted by textilic, mutable materials that are unbound and have their own life.

The seed of a number of fundamental formal questions had been sown through all the work previously undertaken. Is what we call form merely the bringing of things together, allowing them to resonate and attune to one another in a shared space? Is form about working with materials rather than imposing a design upon them? These thoughts sat uneasily alongside the rigorous architectonic work I was undertaking to create stratified and asynchronous tempi. I needed to know whether

[50] Xenakis, I. *Arts/Sciences. Alliages*, Tournai, Casterman, 1979

they could speak to each other, whether the friction between something that had been built and something that had been grown was a fruitful area of investigation.

Around this time, I was asked to compose two pieces; the first, a commission for the opening concert of the London Ear Festival 2018 and the second, a work to be performed at Manifeste Festival 2019 by Ensemble Intercontemporain as a result of being selected by EIC from the Manifeste Academy in 2018. Both pieces were of limited duration (less than 8 mins) and would use harp and marimba, alongside clarinet and oboe (for EIC) and viola (for London Ear). Light preparation of instruments was permitted, electronics forbidden.

The limitations surrounding these pieces proved to be creatively productive. The harp and marimba have limited possibilities for the modulation of frequency and timbre, whilst each of the above-mentioned treble instruments have the possibility of smooth and continuous frequency shifts within limited bandwidths. What I saw were lines and dots; a nodal network which could be enlaced by threads of sounds passing through each point. I could compliment the limitations of one instrument by the affordances of the other. I could use this as a compositional stimulus to create acoustic behaviours which attempt to bridge the gap in-between, only for fundamental organological differences to arise and make this an impossibility.

The limited duration of the piece suggested a focus on a singular idea. As such, I decided to make what could be called continuum music;[51] a piece in which a process or aggregate of sounds moves through various stages of transformation. In the case of *Our Heads*, this resulted in a form which implodes, with a dense and chromatic gradated ritardando slowly falling apart to reveal a harmonic core before reversing its process to end where it began. I again used the architectonic temporal method of *Life of Lines II* to control the rate of change over the course of the process. In this instance, I more explicitly metered time, in part to regulate the density of events, in part, out of curiosity for how metre would lead to a different performative attitude. The course of the slowing of material was directional but fluctuating, with internal tempi changes destabilising the sense of unidirectional flow. In fig.33, we see five panels of differing length move towards the zero point, with a general decrease in density rate from one panel to the next.

[51] A method also discussed in Harrison (2007)

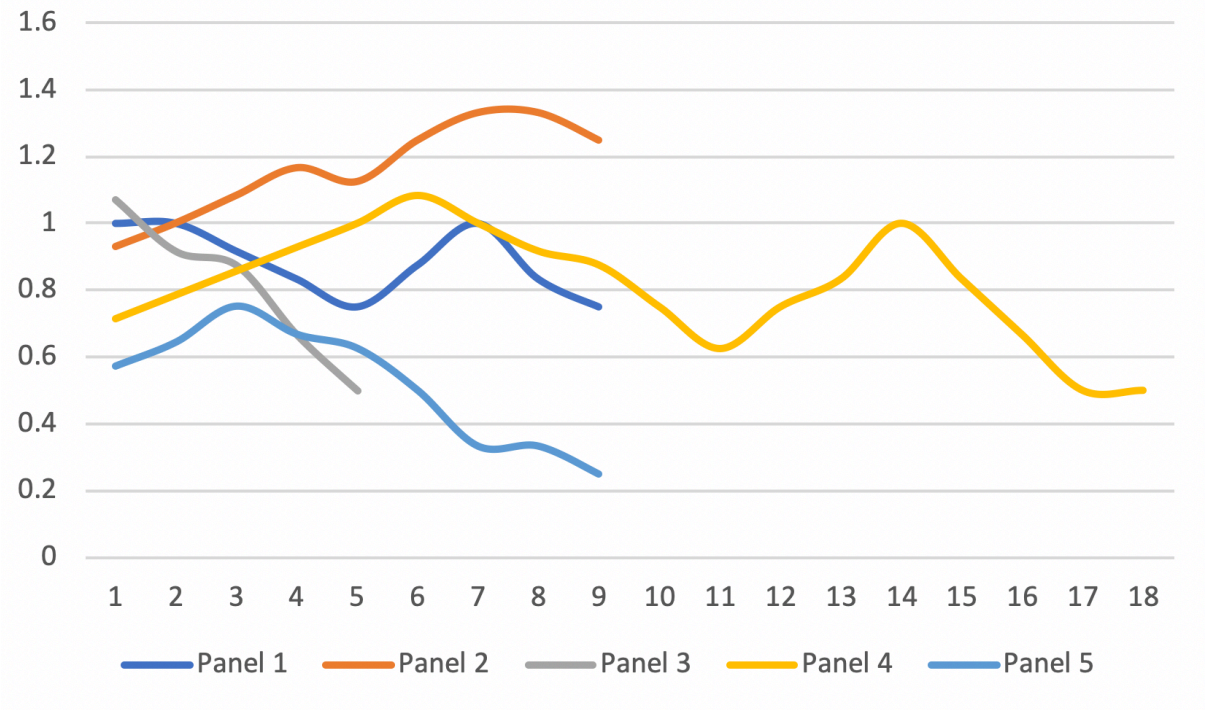

Figure 33 *Our Heads*...Harp, panels 1–5, nonlinear density rate (rit.)

For the pitch material, I knew that I wanted to utilise processes that move in a comparable fashion to the tempi changes indicated above. Due the modulatory limitations of the harp and marimba, smooth glides through pitch space (akin to the Shepard–Risset Glissando– the continuous variant of the Shepard Tone) are impossible, so I decided to create a transitioning series of interlocking diatonic chords and suspensions (initially creating a global chromatic effect), before gradually removing one series to reveal the underlying diatonic nature of the process (shown in the working of fig. 34,35). This is then mirrored exactly, with the piece moving through these changes in reverse towards the chromaticism of the start of the piece.

The assigning of pitch to the harp and the marimba was undertaken on the basis that within each row, each instrument would have two points of contact (shared pitches) alongside four individual pitches, which in total would comprise the full chromatic scale. I would then select a limited number of points from each line for the treble instruments to pass through. These points would dictate the directionality of the line and the morphology of the weave.

The fixity of the harp and marimba material provided an opportunity to counterpoise simple sonic attacks with sounds that were unstable, mutable and fluid. I wanted to draw upon a singular instrumental behavior to do so, a sound that was organic and fallible and that would grow out of and between these points like ivy wrapping itself around the shell of a broken machine. I decided to use glissandi to this end, with the treble instruments more or less solely employing this technique. The relationship between gliding and pointal sounds can be viewed as one of both extension and unification, where differentiated materials seek the behavioural means to bridge the gap in-between.

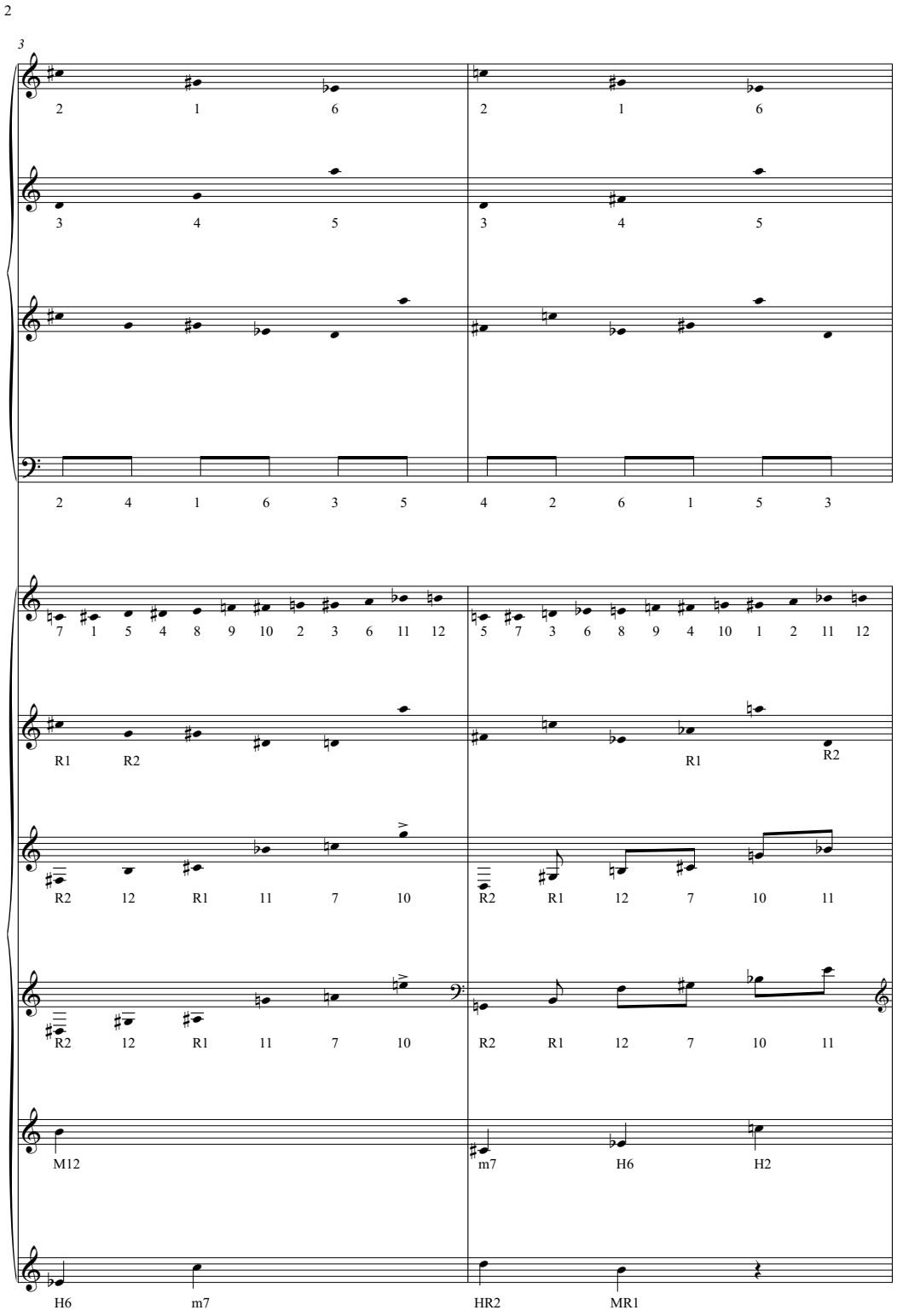

Figure 34 *Our Heads*...pitch space mapping (working chart)

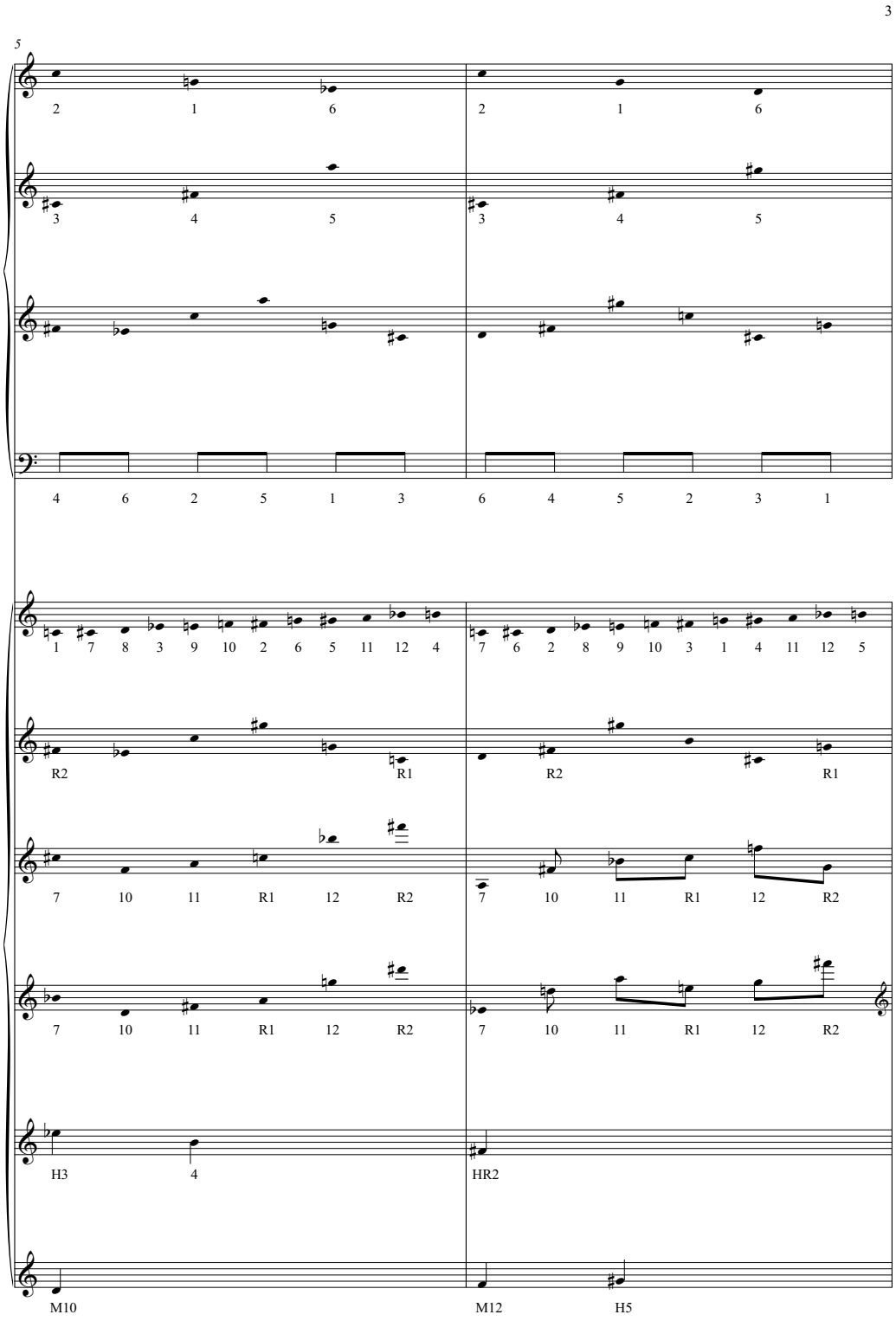

Figure 35 *Our Heads*...pitch space mapping cont.

TRACING TIME: THE GLISSANDO

The exploration of continuously moving sounds in *Our Heads* is representative of a burgeoning area of interest in my work– that of the glissando.

The glissando implies motion. It is the audible trace of time itself.[52] It takes the form of an archetypal morphology, that of the line, which can be found everywhere that we look; from the ground that we stand upon, to the most abstract physical and mathematical theorems. As with any trace, it is the enduring mark left in a surface by a continuous movement.[53] It refers to the force that generates it. It inscribes movement onto the surface of our auditory perception, drawing a line through pitch space and time.

1.1.1.1.1 PAUL KLEE'S PEDAGOGICAL SKETCHBOOK

Lines behave differently depending on how, and where, they unfurl. They can lead us toward, convert energy between, or they can be dragged behind. They can grow and connect, be suspended, entangled, threaded, scratched, scored and etched. They create surfaces and edges. They abound in the nonhuman world and are the

[52] (Iliescu, 2005) 1
[53] (Ingold, Lines: A Brief History, 2007) 43

means through which we tell stories through the stars.[54] For Paul Klee, a line can be active, passive or medial. In *the Pedagogical Sketchbook*, he demonstrates how the energetic flow of a line is dependent on its origin and orientation. They can direct flow or move within it, be goal-oriented or wander freely. They can complement, circumscribe or circulate around an imaginary central point. [55]

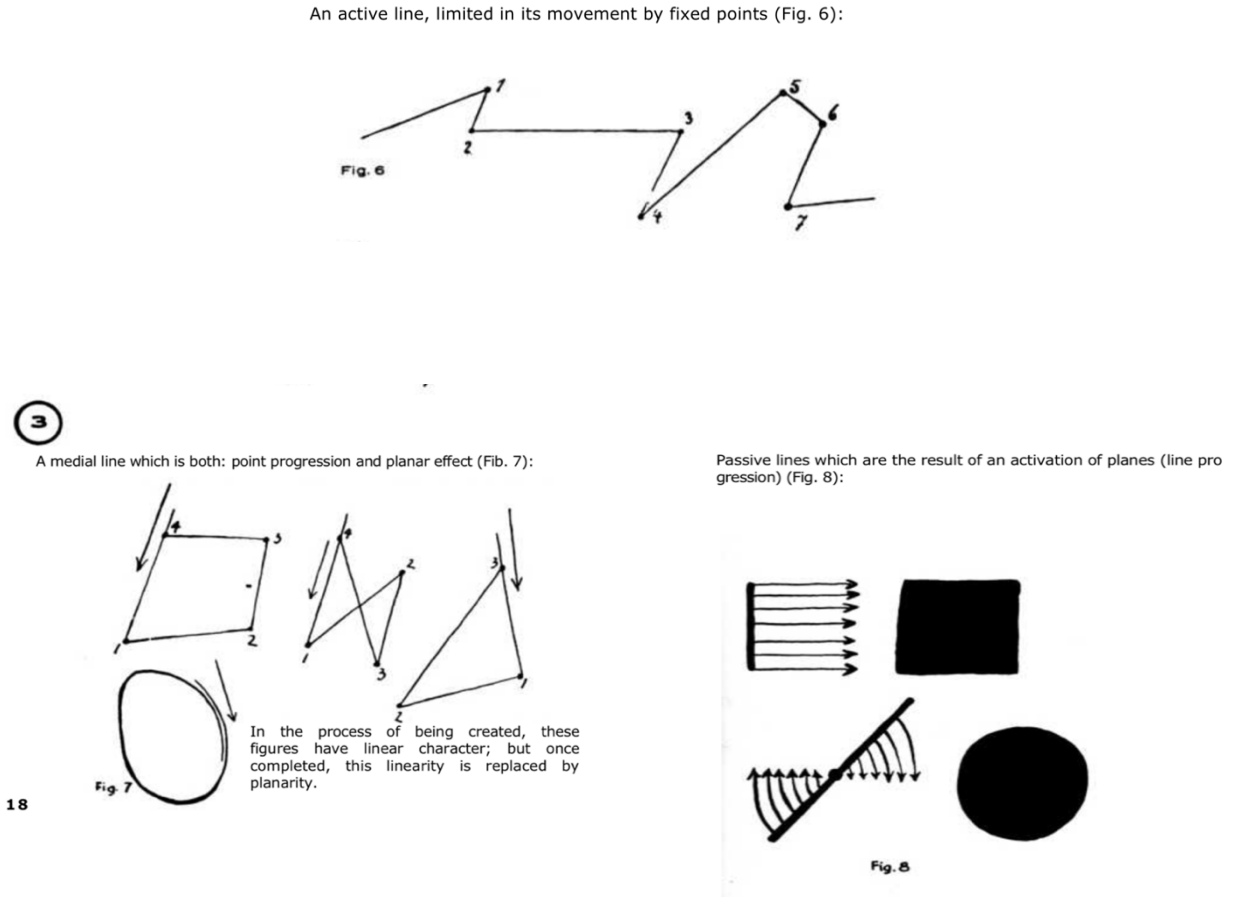

Figure 36 active, medial and passive lines rep. pg. 16-18
(Klee, 1953)

[54] (Ingold, Lines: A Brief History, 2007)
[55] (Klee, 1953) 18,19

1.1.1.1.2 THE SHEPARD TONE

The psychoacoustic impression of the line has been a continual source of fascination for composers and cognitive scientists alike. When combined with pitch circularity, overlapping lines can give the impression of an infinite ascent through pitch space, with no finite origin or point of termination. This psychoacoustic effect has come to be known as the Shepard tone, named after the cognitive scientist Roger Shepard. Shepard generated a complex of sinusoidal tones, each a semitone apart, whose amplitudes were shaped by a stationary Gaussian envelope. Pitch height of these tones is ambiguous, because of the absence of a complete harmonic series.[56]

The compositional rendering of this auditory illusion can be heard in works composed from the renaissance to the present day. Examples can be found in Orlando Gibbons (1583–1625) and John Bull (1562–1628) and all the way through to the 20th century works of Bela Bartok, Sergey Prokofiev, Gyorgi Ligeti, Jean-Claude Risset and Georg Friedrich Haas.[57]

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[56] (Vernooij E, 2016) 2

[57] (Braus, Retracing One's Steps: An Overview of Pitch Circularity and Shepard Tones in European Music, 1550–1990, Spring, 1995) 324

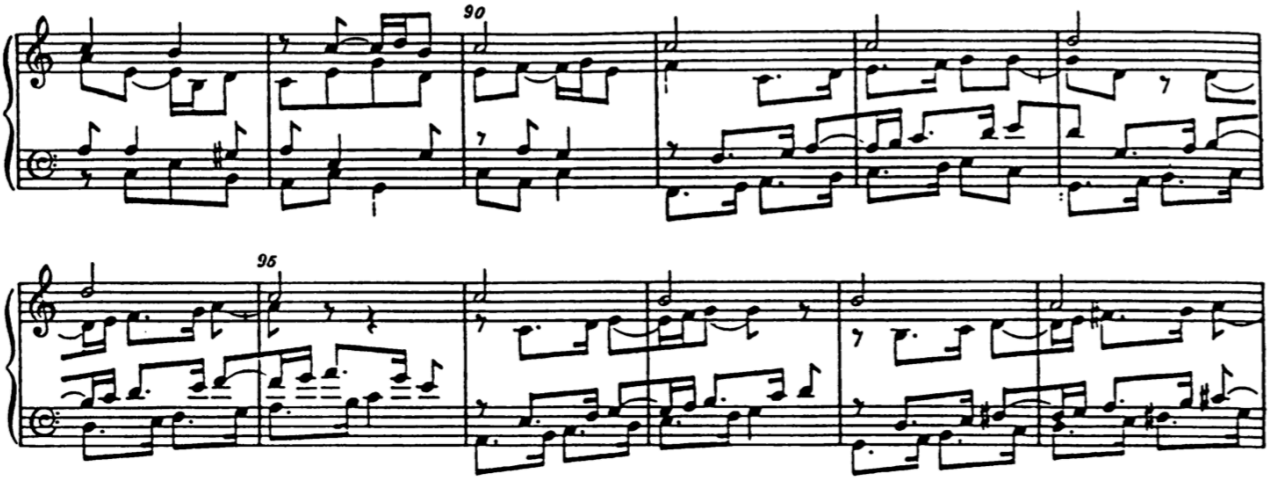

Figure 37 John Bull's *In Nomine VII,* Rep. pg. 324 (Braus, Retracing One's Steps: An Overview of Pitch Circularity and Shepard Tones in European Music, 1550–1990, 1995)

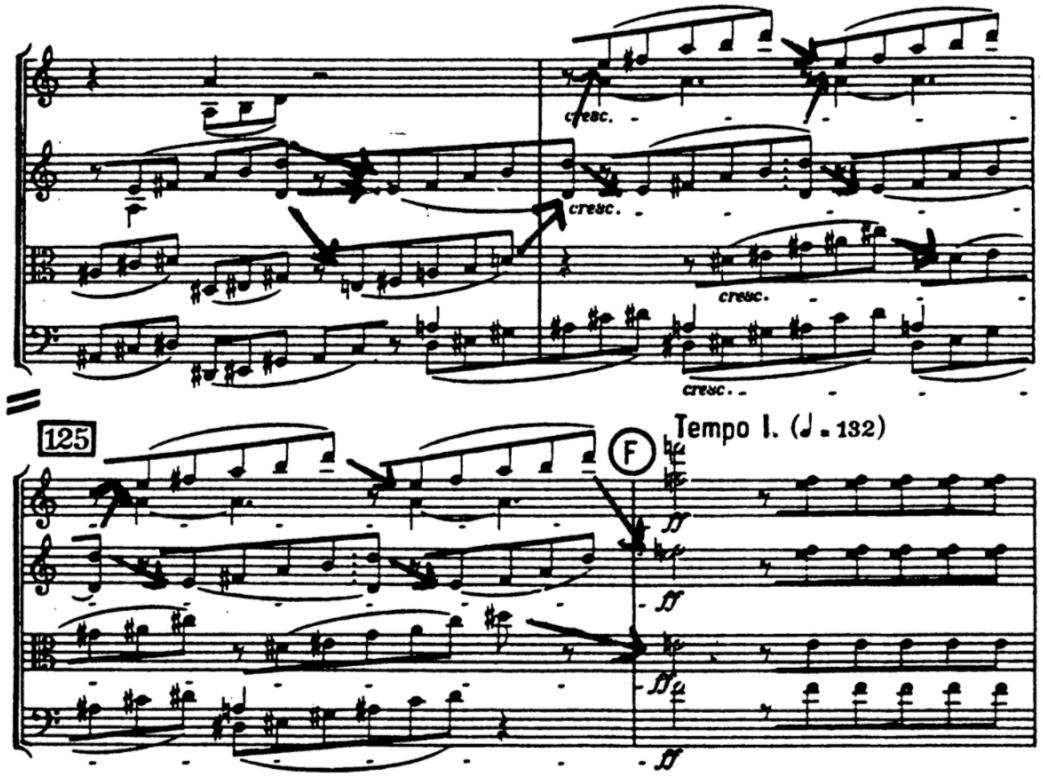

Figure 38 Bela Bartok's *Allegro* of *String Quartet No. 5,* 1936, Universal Edition. Rep. pg. 338 (Braus, Retracing One's Steps: An Overview of Pitch Circularity and Shepard Tones in European Music, 1550–1990, 1995)

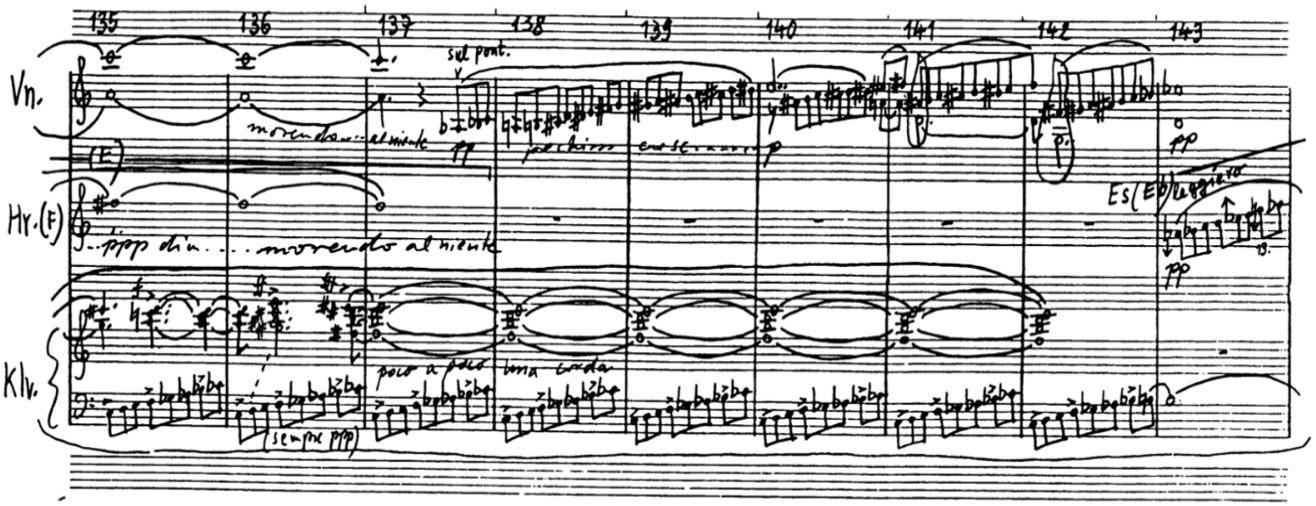

Figure 39 György Ligeti's *Vivacissimo molto ritmico* of *Trio for Horn, Violin and Piano*, rep. pg 343 (Braus, Retracing One's Steps: An Overview of Pitch Circularity and Shepard Tones in European Music, 1550–1990, 1995)

Perhaps the composer most closely associated with the glissando is Iannis Xenakis. For Xenakis, the line is the equivalent of the glissando, and is a morphological archetype defined by movement through an infinite number of points. It illustrates how geometrical figure, natural form and artistic representation are analogous to one another, with the line being one of a number of morphologies that could be taxonomized and used in the shaping and treatment of sound masses.[58] In the below, Xenakis' sonic gestalts are codified to provide the basis for a scale of increasing morphological complexity:

[58] (Iliescu, 2005) 1

Mathematics	**Physics**	**Music, Architecture**
non-being, zero, nothing	empty space	silence, obscurity
point (abstract being)	elementary particle (concrete being)	individual sound, flash-light (sonic being, visual being)
series of points discrete space	series of punctual events discontinuous matter	scales, sieves musical rhythm, visual rhythm *Couvent de La Tourette*
straight line, curve spiral, ellipse	wave, border random walk	glissando, sine sound graphic contour, ray of light
incurved space	continuous matter, flow	sound projection, cluster of glissandi *Pavillon Philips*
complex morphologies topologies	clouds, molecular crowds galactic nebula, turbulences	mass sound, sound synthesis *arborescences*, *Polytopes*

Figure 40 Xenakis sonic gestalts, reproduced pg. 1 (Iliescu, 2005)

These gestalts begin from nothing, move up through simple sonic structures (points) toward complex morphologies and sound masses. In the middle of this scale can be found the line, the connecting thread between elementary particles and continuous matter.

In *Our Heads*, the overlapping marimba arpeggiations attempt to form quasi-Shepard tones. The instrumental mechanism, with its discrete and immovable pitch blocks, means that these Shepard tones are quantized (akin to the examples given above, rather than the smooth glissando of Risset).

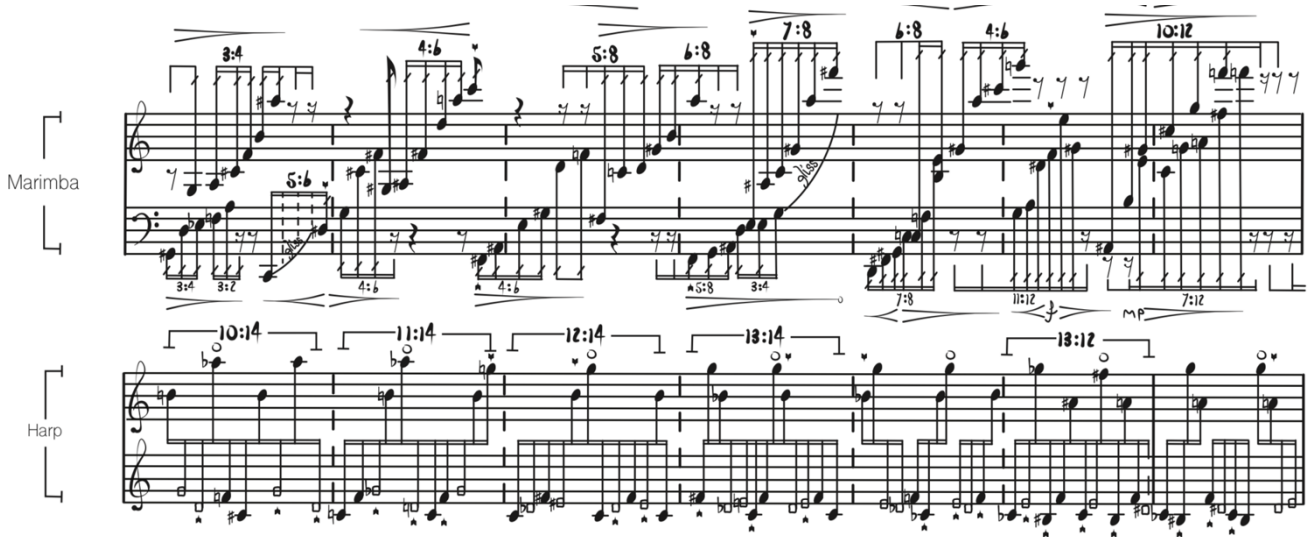

Figure 41 *Our Heads.*. marimba and harp pg. 2, system 1

The harp plays the role of a nonlinear, entropic clock; a continuously degrading line around which the rest of the ensemble entwines. The treble instrument weave connecting lines between the harp and marimba. They move along in part active, in part medial lines. Their glissandi are sometimes limited by fixed points, sometimes circumscribing imaginary centres. As a result, I took a somewhat freehand approach in plotting potential pathways through the piece's pitch space. Merely connecting point-to-point, as Ingold demonstrates, would stunt their growth and shear the line of the movement that originated it. [59] The point, in this instance is not a goal to be reached, but rather a frozen moment in a continuously evolving tracing of time.

[59] (Ingold, Lines: A Brief History, 2007) 75

To this end, the viola in the first arrangement of the piece has multiple possible pathways that can be followed (fig. 42).

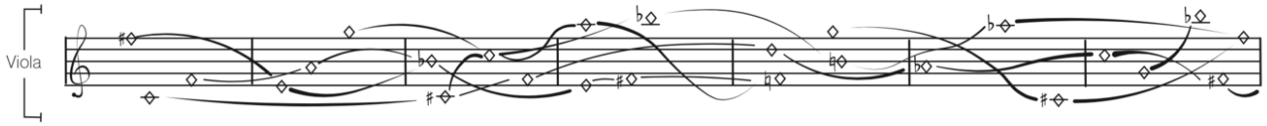

Figure 42 Glissandi lines, *Our Heads..* arrangement 1, viola, pg. 6

The performer actively decides which points they are moving through and how, due to the impossibility of navigating all possible information simultaneously. Inter-instrumental connections are made regardless of the path they choose, but these will be different from performance to performance. In this, the performer's agency is once again inscribed in the score surface of the piece. In the second arrangement, there are no fixed pitch points in the treble instruments part, but rather continual traces of movement with no definite point of arrival.

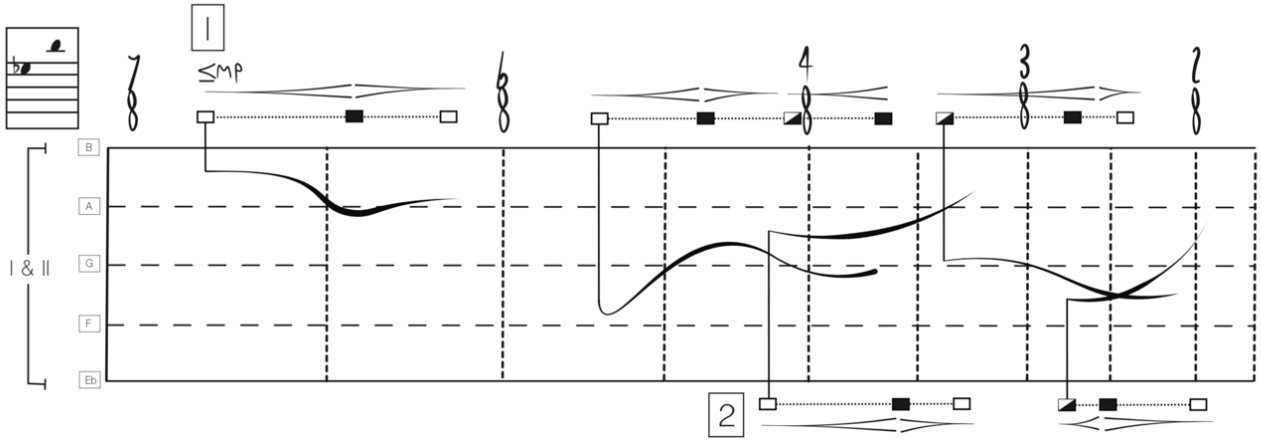

Figure 43 Glissandi lines, *Our Heads..* arrangement 2, treble instruments pg 1.

Our Heads marked the end of the first phase of my research in which I explore rhythmic entrainment from a variety of perspectives. A compositional methodology arose out of this, in which I use processual means to braid temporal strata. I had also begun to develop a graphical vocabulary, premised upon the morphology of the line, which I would continue to develop in subsequent work.

Tuning in

'*The wind then turns into breeze, the base of the earth into resonance, the crackling fire into a peaceful source of heat, water, the surface against the bank, cooing like a stream.*

Life is there.

Another level, another theme begins.' [60]

–Eliane Radigue

By the end of the first phase of my research, I had found a way to braid sounds in time. A variety of approaches to harmony and noise had been used throughout, and whilst this had served a purpose in the works created, I became aware of a need to explore my relationship to frequency and the pitch-noise spectrum in a more detailed way. I also became keenly aware of the sheer density of events in each of the pieces I had produced. Whilst minimal formal means and repetitive structures were being employed throughout, I had not attended so carefully to the inner life of each individual sound. I wanted to tune-in to the interiority of these

[60] (Radigue, The Mysterious Power of the Infinitesimal, 2009) 47

sounds. Through moving away from discrete rhythmicity and dense polyphonic weaves, I could explore the emergent properties of internal oscillations produced through frequencies that relate to each other at an elemental level.

My arrival at this was the result of an ever-developing view of how musical materials give rise to form. The question of why a sound is produced at a particular moment in time, and how an event gives rise to a possibility space for future events had been central to my thinking from the start. Initially this led to the reduction of materials, with a limited number of elements entering into varied relationships over time. I was looking to explore whether the properties of these materials could be brought into alignment with the structural procedures which I was working with. These were predominantly algorithmic in nature, with recursive structures producing interrelated and entrained patterning. Through composing these pieces, I came to realise that it was the distillation, reduction and revelation of materials that held the greatest attraction for me, not the processes used to organise these materials, or to enact a particular formal model. Their block-like structuring meant the solidity of acoustic surfaces was being maintained; that sounds were treated ostensibly as static entities along the sonic continuum that rarely developed beyond accessible points of contact with the initial sound. Their acoustic properties were secondary

to the formal development of material. To paraphrase Ingold, I was joining materials up, rather than joining with them.[61]

I CONTAIN MULTITUDES

This realisation came to a head prior to composing perhaps the most innocuous, but in many ways, the most important piece in this portfolio, *I contain multitudes* for solo accordion (2017). *507* had been completed in November of the previous year. In this piece, alongside the others found in the first phase of research, I tested rhythmic entrainment and the segmentation of time, with a view of understanding how discrete temporal units impact ensemble play. Through appraising the work undertaken in these pieces, I found value in their reduced quality and their engagement with an expanded field of materials but felt the loss of the fine-grained detail of the sounds themselves, and the space to allow these details to acquire weight and density of their own. Furthermore, I felt the loss of harmonic resonance in the pitch relationships that were being utilised in these pieces. I therefore decided to undertake a focused instrumental study in which a reduced palette of sounds

[61] (Ingold, Correspondences, 2017) 77

would be explored to produce emergent acoustical phenomena, and that these phenomena would be afforded the space to be able to take shape and speak.

I contain multitudes was the result of this study. In the piece, the register of both manuals of the accordion are almost solely confined to the top octave of the instrument. Micro-deviation in pitch between manuals means that beatings emerge when the 'same' pitch is produced on each manual. These are instable and unproducible on every pitch and need to be coaxed gently out of the instrument by the performer who supports their production with a delicate shaking of the bellows (fig. 44). The emergent and relational qualities of these beating patterns produce moments of tension and release within the structure, creating a sense of internal movement.

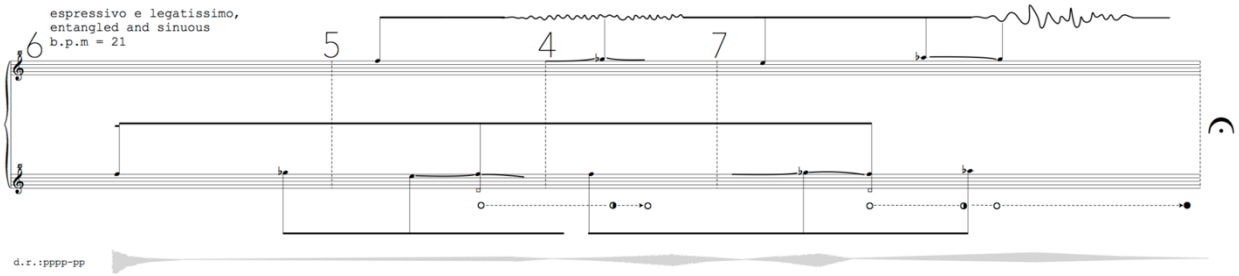

Figure 44 *I contain multitudes*, 2nd system

My focus upon instability and wave-like dynamics meant that providing discrete (classical) dynamic indications for these sounds would only have served to limit

their essential quality. I wanted sounds to evolve continuously rather than having pre-determined points of arrival. As a result, I developed the dynamic range indications initially used in an instrumental context in *Life of Lines II* to include a waveform, which the performer would then follow in relation to the beatings produced. As with any wave multiplication, accordion beatings are significantly louder than a single frequency, so this was cause for extreme sensitivity on the behalf of the performer to move within both the emergent amplitude of the beating and the global dynamic profile indicated.

Although I build upon the organisational principles used throughout the first phase of research in *I contain multitudes*, the acoustic surface represents a shift in compositional sensibility, with timbral and temporal properties emerging out of the intertwining of strands of material. I had magnified and zoomed into the pointal events found throughout the first phase of my research, revealing the oscillating lines found within. Through the piece, the harmonic space slowly expands outward, culminating in a vibrating chord which blooms and then disappears into the air. Further to this, the importance of the minor 3rd as an intervallic structure, points towards a more direct engagement with pure ratio and triadic harmony, with *I contain multitudes* being a first attempt at exploring this.

HARMONIC KNOTS

Composing *I contain multitudes* had given me pause for thought. Is harmony a psychoacoustical phenomenon produced through the interaction of sonic interiors? My understanding of harmony was moving away from external aggregations to what Eliane Radigue has described as 'the mysterious power of the infinitesimal'.[62] I was looking to be 'submerged in a continuous sound flow where perceptual acuity is heightened through the discovery of a certain slight beating, there in the background, pulsations, breath'.[63]

I wanted to create c(h)ords that oscillate to a greater or lesser extent depending upon the density, tensility and complexity of the knotted result. My work began to move towards pure ratio (just intonation) harmonic structures that are heard in combination with tempered instruments, with beating patterns creating resonant harmonic spaces that vibrate through the interference of oscillatory patterns. This, of course, is a further example of entrainment; the phasing of frequencies that are bought in and out of sync with one another. As their wave patterns interfere with one another, temporality in the form of beating emerges.

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[62] (Radigue, The Mysterious Power of the Infinitesimal, 2009)
[63] (Radigue, The Mysterious Power of the Infinitesimal, 2009) 49

BLACK SUN ROTATION

In the winter of 2017, I was selected by the Royal Scottish National Orchestra to compose two works for their Composers Hub programme. The limitations of these works were clear from the start; a short work of less than five minutes for chamber orchestra to be workshopped within a thirty-minute period, and a work of less than ten minutes for a reduced symphony orchestra to be workshopped within one hour. The limited time for rehearsal and performance meant ruling out extensive use of techniques that the orchestra may not be accustomed to working with, the use of scordatura or alternative tuning systems, and a score surface that would require lengthy study or reflection. With that being said, I wanted to push the group to explore new sounds in a way that would result in a performance within the given timeframe, whilst also developing my practice.

Having composed *I contain multitudes* earlier that year, I was keen to continue exploring the interiority of sound and the way in which harmony is a function of these interiors. I wanted to make work in which the ensemble resonates together to produce an oscillating, shimmering mass of sound. Each individual line would contribute to the resonance of the whole, with the piece taking the form of a slowly

rotating harmonic complex whose weight finally leads to the dissolving of lines into a granulated cloud of points. The harmonic profile of the piece would radically differ to the work previously composed, with the view of moving towards more nuanced working with frequency when opportunity allows.

In *black sun rotation,* I move through a series of closely related overtones derived from E1 (frequency=41.203), with a smooth line of travel producing a series of diatonic chords. This was an extension of the work undertaken in *Our Heads*, although in this context, the harmonicity of this material would not be veiled by multiple pitch processes. I assigned each individual instrument a temporal line (using the methodology developed in the first phase of research and smoothed out into a continuum in *I contain multitudes*) which phase in and out of sync with one another to produce an oscillating global result. In each part, I use lines of varying thickness and shape to indicate dynamic shape and/or morphology of sound (fig. 45). These are interpreted freely but correspond to the onset, continuant and decay of the sound in question. I reverted to using space-time notation in the piece as a means of again subverting the rationality of the underlying process, and to encourage a more engaged approach to listening to one's part in relation to the whole, as in previous works such as *Life of Lines II*.

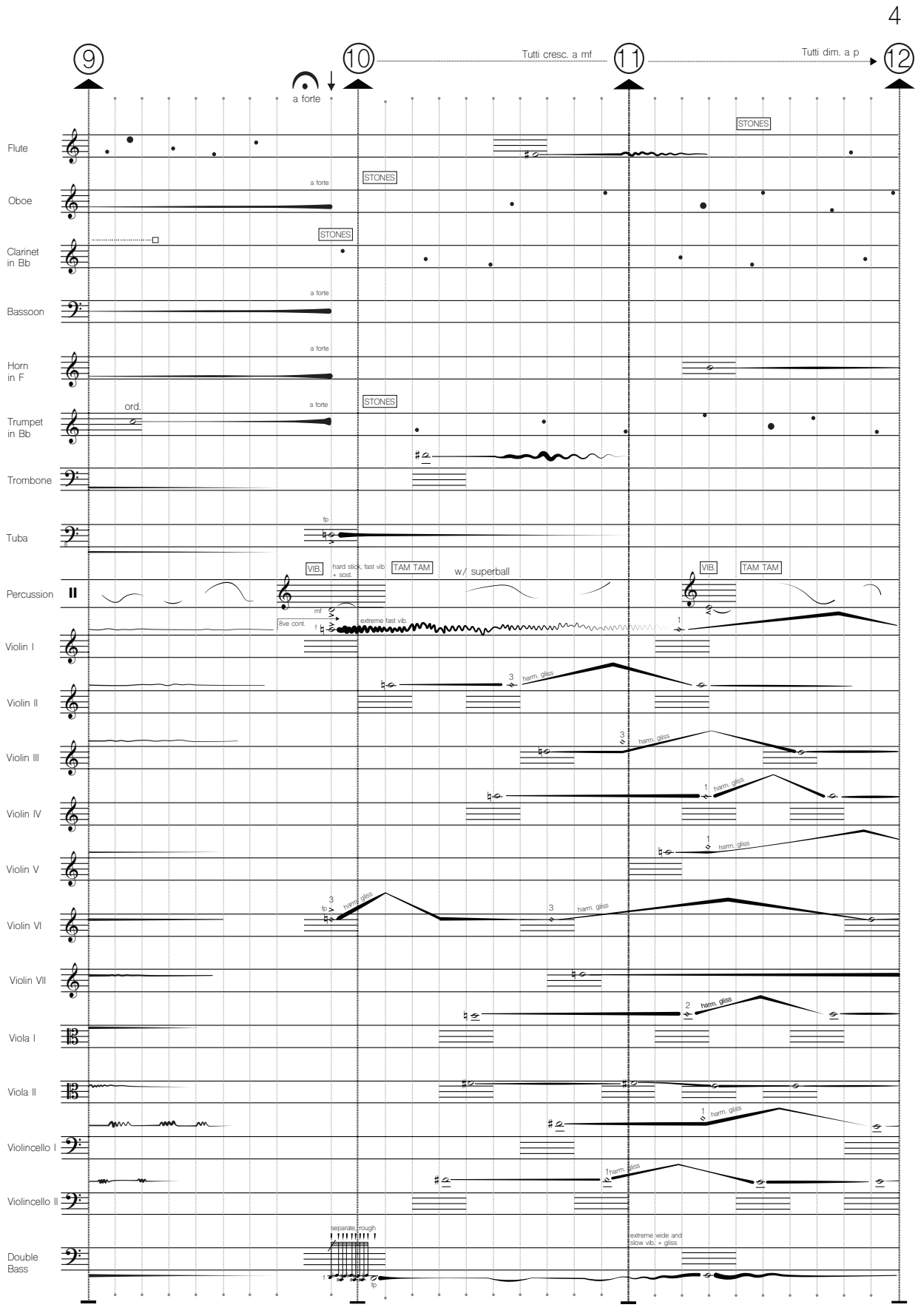

Figure 45 Morphological lines in *black sun rotation* indicating frequency modulation and dynamic change

RAW

In *Raw*, the diatonicism of *black sun* becomes a means of exploring instrumental synthesis. A large number of temporal lines enliven totemic harmonic structures that reveal themselves to be oscillatory processes through the addition or subtraction of timbral strata. This work opened my thinking up to form being the sensing out of resonant complexes through additive and subtractive timbral synthesis. Synthesis exposes each instrumental sound as a point along the harmonicity–noise continuum. I weight the resulting sounds against one another, in relation to a sliding scale of timbre. I create a form by shifting through instrumental groups, exploring the harmonicity of the sound world from multiple timbral perspectives. Depending upon their timbral make-up, these complexes can shift towards noise or more complex harmonic structures depending on their compositional context. They can become spaces in which the inner dynamics of the sound spectrum can be explored.

The piece opens with a tutti C Major chord which collapses, modulates and then recombines over the course of the piece. This process of formal implosion and resynthesis can be found in various guises throughout the portfolio. I view this as an archetypal process of transformation, a ritualised cutting of prior experience toward the emergence of an entity fundamentally altered through its becoming. To

achieve this, the piece swings between the extremes of both the harmonicity-noise and rhythmic entrainment spectra. The first section of the piece culminates in extreme rhythmic and harmonic entrainment- tutti diatonic chords, in which each frequency and event is a function of another (fig. 46). The weight of this entrainment becomes increasingly heavy through modular repetition. It begins to crack and crumble under its own heft to reveal a cloud of points (fig.47). Aggregated and asynchronous clouds of attacks grow and recede, out of which emerges a fragmented, tentative melody, hocketed between the low instruments of the ensemble. This melody blurs and becomes a harmonic structure, before dissolving into the extreme high end of the registral spectrum. This begins a process of re-synthesis, with the initial diatonic chords emerging and moving through a series of stepwise modulations as it seeks a new harmonic ground to anchor itself to. This is unsuccessful, and so the process of rarefaction continues, petering out into almost nothing, with a solo violin playing an extremely high pitch which is left wavering, alone (b.89-90). What follows is a coda- a doleful rendering of an attempt at integration.

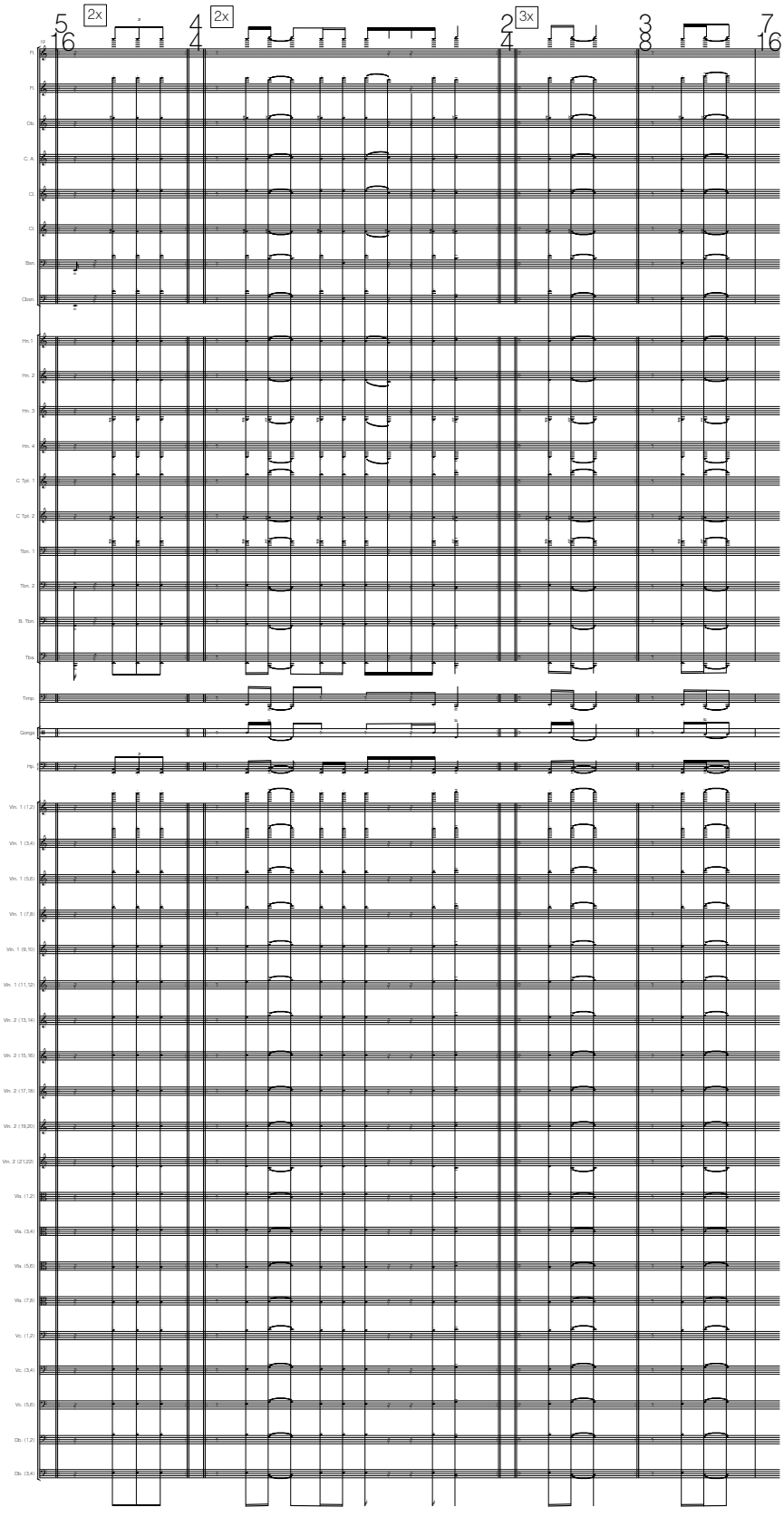

Figure 46 strong entrainment, *Raw*, b. 19–23

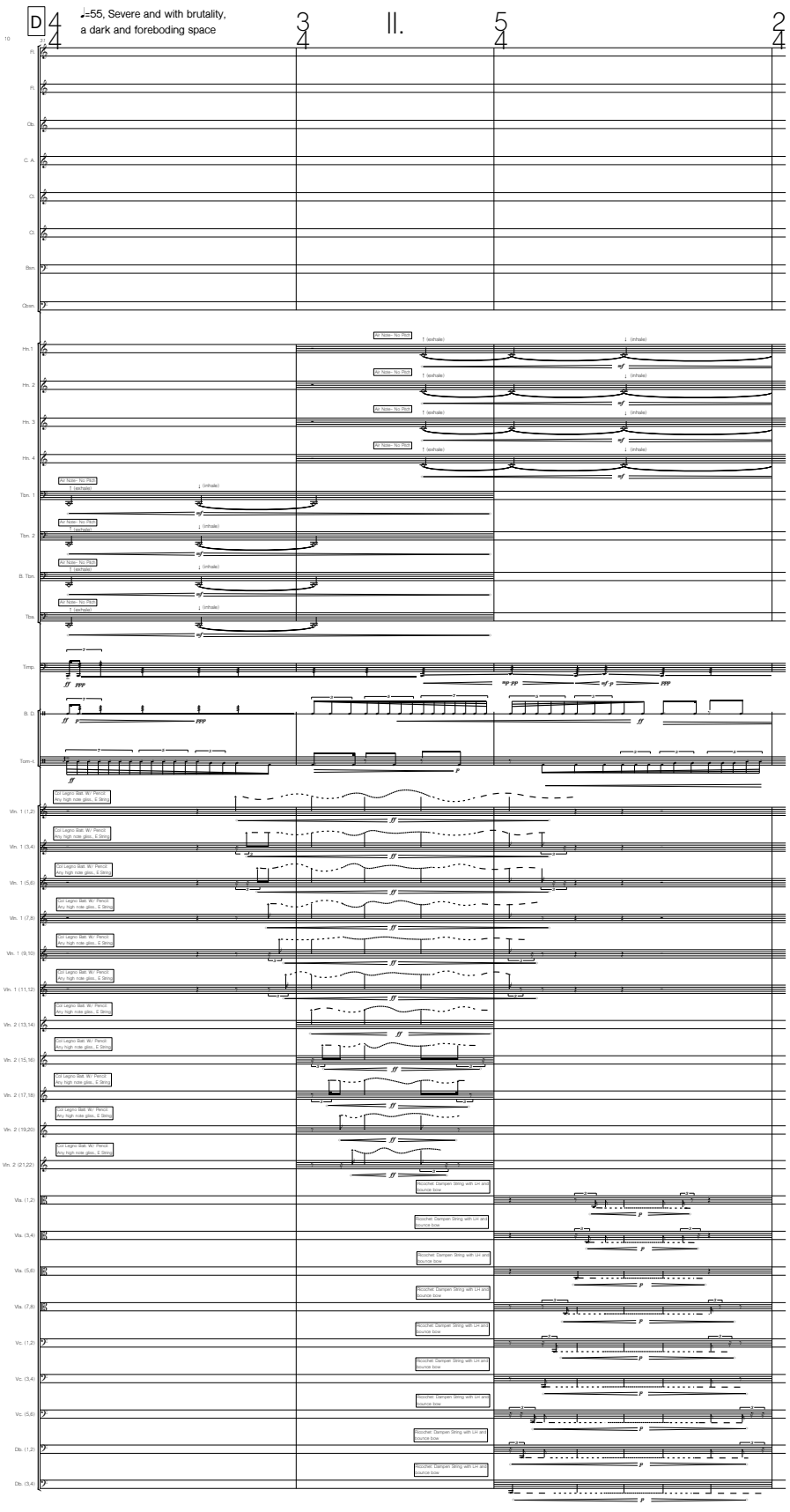

Figure 47 Rupture and the revealing of instrumental mechanism, *Raw*, b. 31–33

MUSIC OF REVELATION: VIVIER AND CZERNOWIN

The influence of two quite different musical figures, Claude Vivier and Chaya Czernowin, looms large over the sound world of *Raw*. In the work of both, one can hear enquiries into identity through negotiations between past, present and future. Confrontations between the body and internal experience creates music of revelation in which the other is assimilated within oneself. Whilst these topics are pursued in radically different ways in their work, both create highly individual worlds in which songs transcend language, personal mythologies are evoked through dream, and sounds are impossibly fused to evoke awe.

1.1.1.1.3 CLAUDE VIVIER

I had been fascinated by Vivier's work ever since being a postgraduate student at Oxford. Hearing *Kopernikus* for the first time was a revelation to me. Quite unlike the profusion of 'objective' music made by many of his contemporaries, Vivier composed, as Bob Gilmore states, 'in order to access an inner world: as a means of confronting loneliness, darkness, terror; of negotiation a relationship with God; of voicing an insatiable longing for acceptance and for love.'[64] His work explores

[64] Bob Gilmore Boosey catalogue pg. 3

notions of identity and radical alterity through a meditation on that which is beyond. His pieces are journeys of discovery through a strange landscape populated by memory, both real and imagined. To my ears, there is something audacious in the expressive and forceful directness of Vivier's music. In two of my favourite works, *zipangu* [65] and *et je reverrai cette ville étrange*,[66] melodic lines abound and are woven through time. Harmony is treated as the spectral function of these lines, with the ensemble becoming a resonant chamber in which melody reverberates. Vivier's use of ring modulation as a technique to produce these harmonies is akin to the additive synthesis used as an orchestrational principle in the outer sections of *Raw*, although in this instance the frequential relations are much simpler than those found in works such as *Bouchara*[67] or *Kopernikus*.[68] In the case of *Raw*, I was looking to create a diatonic chord which burnt so brightly that its harmony becomes indelibly scorched into our inner ear. This chord modulates, becoming even brighter, with its reiteration and internal oscillations ultimately breaking surface to form a raw and pulsing expressive canvas. Although I am not convinced that I achieved this, it was a further step towards exploring the relational interiors of tone through synthetic models.

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[65] (Vivier, Zipangu, 1980)
[66] (Vivier, et je reverrai cetter ville étrange, 1981)
[67] (Vivier, Bouchara, 1981)
[68] (Vivier, Kopernikus, 1980)

1.1.1.1.4 CHAYA CZERNOWIN

Chaya Czernowin's music is raw and physical in quite a different way. It is music of scale and of volume, with colossal and untameable masses of sound zoomed into, to reveal the fragility found within. Her work ebbs and flows between states of being, evoking monolithic and crystalline structures from one moment to the next. Time is knotted, looping in and through itself to point to sonic memories of material states which may have yet been heard.

As Trevor Baca states, Czernowin's music is animated by 'an imagined physics–giving rise to complex types of musical metaphor' found in the elasticity of rubber, the growth of crystals and the movements of a pendulum.[69] For Michelle Lou, these follow,

> 'the laws of nature (in an invented landscape), of energy, entropy, and transference. In fact, her music is concerned with physics: matter, energy, atoms, particles, masses and their interactions and motion over time that is variously fragmented, altered, static or abrupt. She does not prescribe the listening experience, but rather lays the foundation for personal

[69] (Bača, n.d.)

> observation. It is this balance of addressing both the sensing body and the grasping mind in her music that motivates her, a balance that is on the edge of tipping, seeking a third realm, one that is on the fringe of consciousness'.[70]

As in Vivier, melodies abound. Czernowin states that her work since the 90's has a lot to do with 'What is the line? What is one strand of the line? Is it divided or is it comprised of several strands? Or is it one isolated strand?'[71] These lines form the basis of an orchestrational methodology in which the ensemble becomes a meta-instrument, a mechanism with unstable and oscillating parts through which emerge acoustical qualities that are beyond the sum of the individual parts.

The middle panel of *Raw* is informed by Czernowin's approach to the physicality of the sound body. Out of the harmonicity of the first panel comes a cloud of points. These reveal the instrumental mechanism which had been veiled in the preceding section; the breath of the wind instruments, the points of contact between bow and string, the unpitched contact between mallet and skin. The piece tips towards the noise end of the timbral spectrum, with tactile sounds resonating within a cavernous

[70] (Lou, n.d.)
[71] (Dusman, 2016) 465

and dank chamber. While the harmonicity of the sound masses on either side are less likely to be heard in Czernowin, these sections also owe a debt to the way in which Czerrnowin (as well as Scelsi and Xenakis) combine instruments to make complex global morphologies within which sonic strata, emerge, shift and recede.

Both *Black Sun Rotation* and *Raw* were made with an awareness that the context of their performances would not facilitate a more detailed exploration of harmony or noise at that stage. In retrospect, it is clear to me that I still have much to learn about working with the massed forces of the orchestra and that these pieces are sketches for future pieces.

JAMES TENNEY'S ARBORESCENCES

The harmonic underpinning of the subsequent pieces in this portfolio are to a large extent indebted to the arborescences of James Tenney. In his last work, *Arbor Vitae* (2006), Tenney creates branches of harmony that extend algorithmically out of a root frequency (fig. 48). A limited number of harmonics are derived from this base

frequency and then multiplied against one another, generating relational trajectories that extend outward into harmonic space. Tenney then applies the flow of the algorithm holistically to the duration and dynamic of each branch, resulting in a process-based composition in which the initial conditions give rise to the formal development of the piece. (Winter, 2008) This is a process of attuning to the infinite spaces of the interiors of tone. It is the unlocking of a relational field found within. I decided that the next phase of my research would explore these interiors alongside the bodies that transmit them.

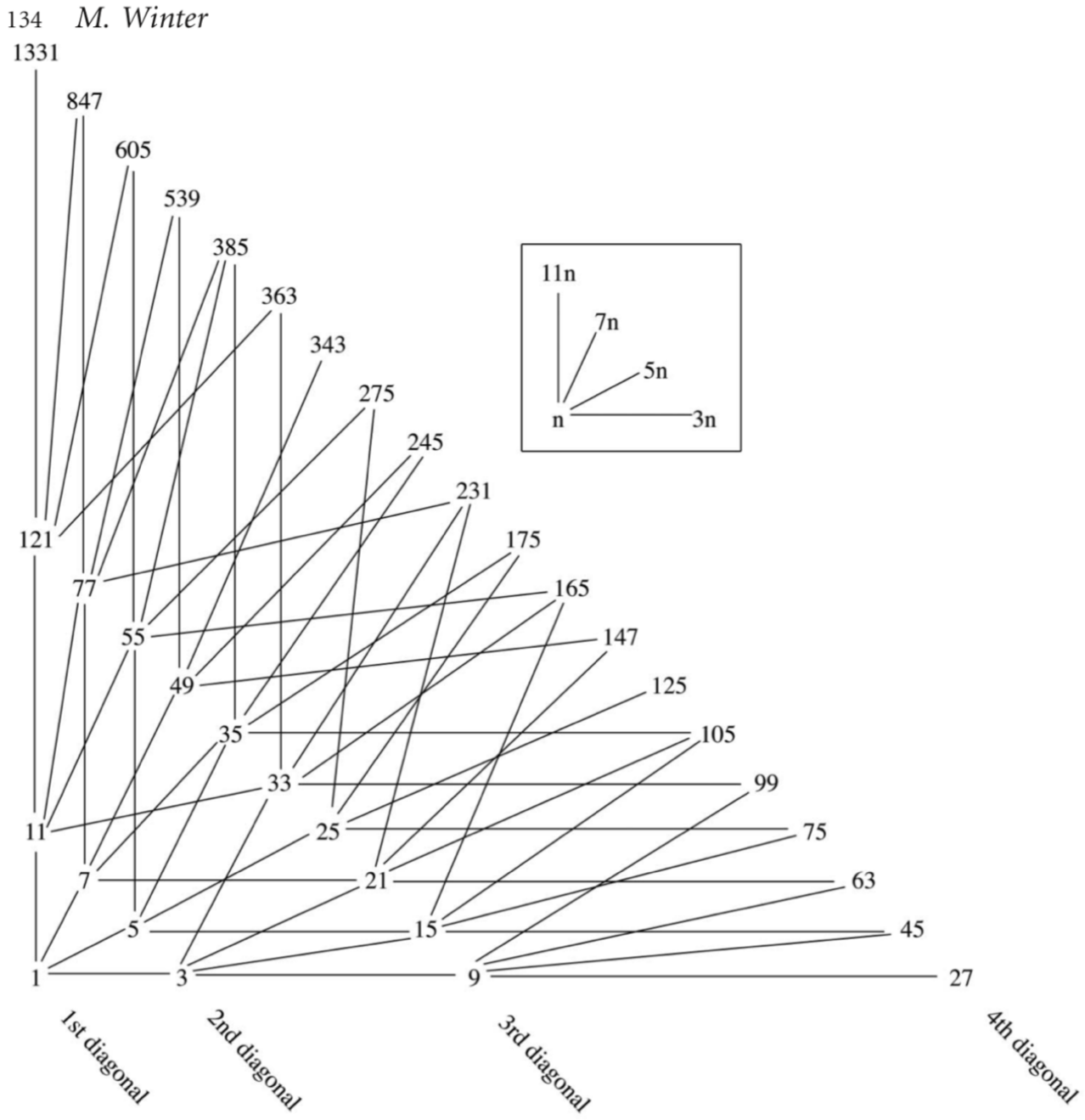


Figure 48 James Tenney's arborescences, rep. pg 134 from (Winter, 2008)

AMONG

'Media worlds are phenomena of the relational. The one or the other may be just as plausible from the way the objects are looked at as the bridges and boundaries that have been constructed between or around them.'[72]

–Siegfried Zielinski

Making music often involves instruments. Observing this may seem rather facile in the context of a thesis, but its implications for my compositional work are anything but. I am fascinated by the ways in which tone-producing bodies are in mediating relationships with other bodies and the environment. In this, instruments are, and have always been, media. To follow on from Marshall McLuhan, they are extensions of consciousness- knotted lines projecting out of the human hand into complex socio-cultural domains.[73] This, of course, is not limited to the instrumental body; the hand, pencil, microphone, speaker, score, computer, notational software, hard drive, concert hall, data network and social media platform are just a few examples

[72] (Zielinski, Deep Time of the Media, 2006) 33
[73] (Mcluhan, 1964) 6

of the media encountered along the pathway to sharing sound work today. All of the above are communication technologies that transmit information by technical means– instruments used to form relationships with one another, and the world.

It was the summer of 2017 when I first read Siegfried Zielinski's *Deep Time of the Media*. Zielinski is a leading figure in the German humanities, who has developed a trans-historical notion of media as 'mediality' ('*Medialität*) in which both material and imaginary carriers of information qualify as media, from CPU's to angels.[74] His writing had a profound impact on me, not least in the palpable sense of joy in sharing radical conceptions of the way in which our perception is, and has always been, mediated. Zielinski's (an)archaeological tracing of media through to the classical and renaissance periods exposed me to techniques of hearing and seeing that are much older, and often more wildly inventive, than the mass entertainment media that abounds today. Through discussion of towering experimental figures such as della Porta, Kircher, Ritter, Galvini and Fludd (fig. 49), what comes into focus is not solid matter but fewer and fewer material objects of study,

> ''light and shadow, electricity and conduction, sound and transmission, magic and illusion, vision and stimuli—in short, conditional phenomena.

[74] (Bunt, 2012) 94

> Fleeting and contingent, the phenomenal world lured into visibility by instruments whose ingenuity often eclipsed their discoveries.'[75]

Medialities are not limited to music; art and communication (in fact most human endeavours) require things in-between for them to be perceived by others.[76] These things produce temporalities, or at least perspectives on time, that are quite unlike clock time. Photography freezes time to a two-dimensional still, phonography renders time permanently available and cinema ossifies time, creating an illusory record of bodies in movement.[77] Telegraphy and telephony shrink the time and space it takes to communicate information. Whilst the former methods of mediation are characterized by inscription- surfaces etched with memories that await revivification, the latter are transmissional, in that they afford communication over great temporo-spatial distances.[78] In the visual arts, Michelangelo's chisel and Durer's squares all the way through to Warhol's filmstrip, Abramovic's flesh and Turrel's light are medial means to simulate and transform our perception of the

[75] (Zielinski, Deep Time of the Media, 2006) xi
[76] (Zielinski, Deep Time of the Media, 2006) 276
[77] (Zielinski, Deep Time of the Media, 2006) 31
[78] (Khan, 2013) 19

phenomenal world. As Zielinski states, ‘all techniques for reproducing existing worlds and artificially creating new ones are, in a specific sense, time media’.[79]

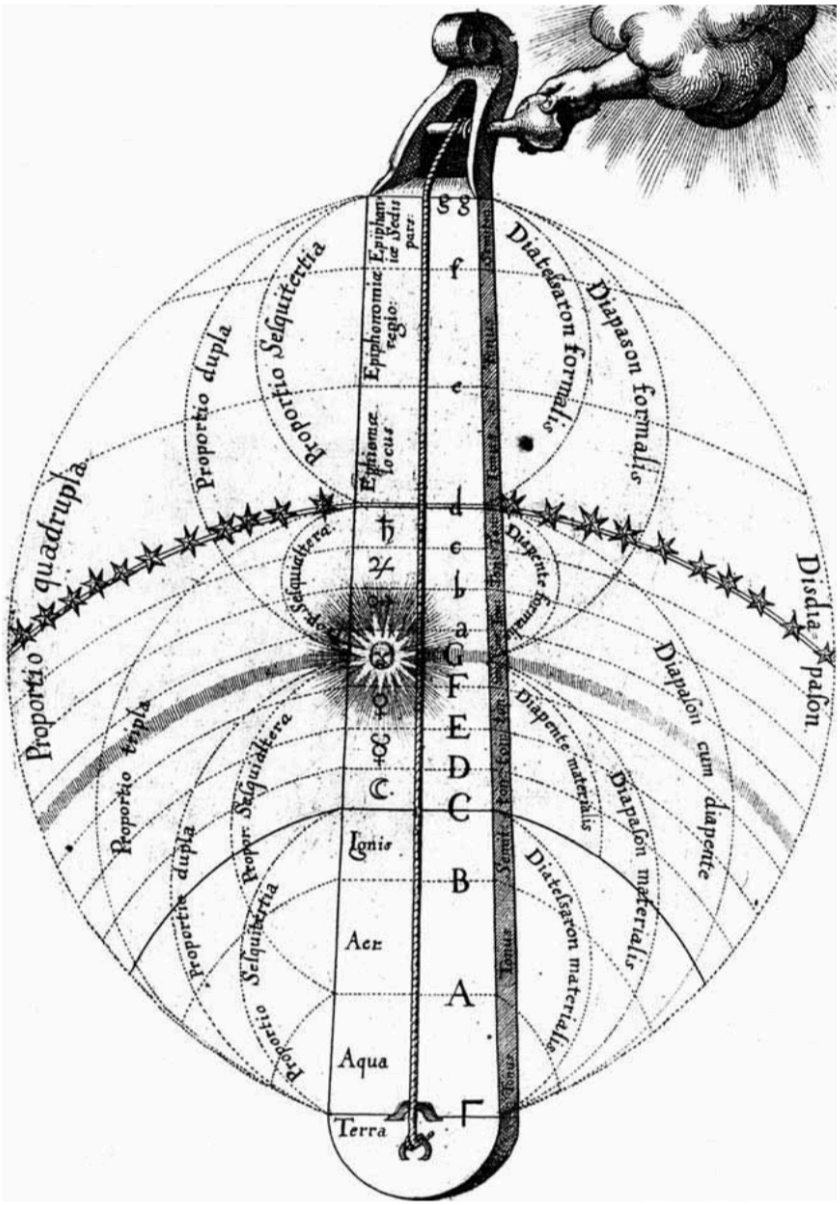


Figure 49 “Musica mundana”: Fludd’s monochord with the principles governing the intervals and the hand of the Great Pulsator, who is tuning the instrument (Fludd 1617, p. 90). Rep. pg. 108 (Zielinski, Deep Time of the Media, 2006)

[79] (Zielinski, Deep Time of the Media, 2006) 31

Reading Zielinski exposed me to the ways in which the material properties of media modify our behaviour towards phenomena. That the instrument is integral in shaping our experience of becoming-with the world, and that exploring media (particularly those that are electric) means engaging with raw, oscillatory and contingent states of matter.

This had great implications for my compositional thinking. It became clear to me that what we refer to as timbre is the phenomenal result of the medium, the unique acoustical imprint of each sound producing body (its formant). Timbre is the emergent acoustical result of that which tangible materials have to teach us. The paths tread by figures mentioned by Zielinski are ones of joining with the oscillating and unruly rhythmicity of raw energy and matter, rather than imposing preconceived formal notions upon things which have their own vitality.

Moreover, media have their own histories and webs of association which extend well beyond the human and certainly my limited time and experience with them. Making art with medialities in mind means thinking across sensory, perceptual and conceptual strata to grasp the liveness of connection. My contact with them is just one point within a much broader and enmeshed experiential network than I could possibly fathom.

Zielinski's conception of media and media art is wide-ranging, ahistorical and not focused on particular movements or locales (say, the uprise of futurism in Milan in the early 20th century or the installation art in New York of the 1960's). Neither is attaching the prefix 'media' or 'digital' enough to assert that the art being created meaningfully engages with medialities. In the context of art practice in the late 20th and early 21st century, the optical sound films of Guy Sherwin (*Cycles*,1972)[80] the projector performances of Bruce McClure (*Build my Gallows High,* 2014) [81] as well as the postdigital coding of Ryoji Ikeda's video work (*continuum,* 2018)[82] have all been important points of discovery for me. Sound art relevant to my own work include the no-input mixing desk work of Toshimaru Nakamura (the *NIMB* series, ongoing),[83] the instrumental engineering of Clara Iannotta (*skull ark, upturned with no mast*, 2017-18)[84] the installation work of Ashley Fure (*Veer*, 2012)[85] and the warped tape loops of Taylor Deupree and Marcus Fischer (*Twine,* 2015).[86] While none of these artists may identify as 'media artists', their work tangibly investigates

[80] (Sherwin)
[81] (McClure, 2014)
[82] (Ikeda, 2018)
[83] (Nakamura, 2018)
[84] (Iannotta, 2017-18)
[85] (Fure, Veer, 2012)
[86] (Deupree, 2015)

the way in which the instruments of art suggest modalities of engagement, and that these shape our perception of the phenomenal world.

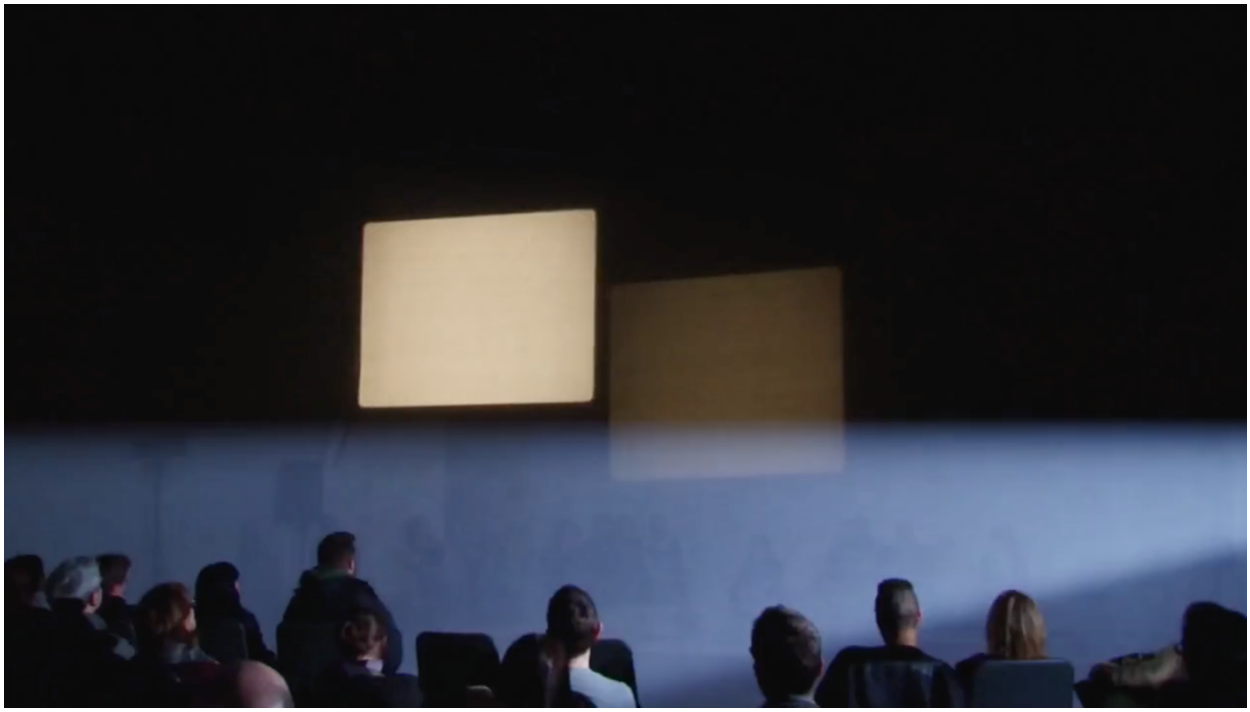


Figure 50 Still from Bruce McClure's 16mm projector performance *Build my Gallows High*. (McClure, 2014)

THE TRACES THAT REMAIN

At the end of the summer of 2018, I was selected by the London Symphony Orchestra to write a new piece for their Soundhub programme.[87] Excitingly, I had the time and resources to make mistakes, to experiment and to move through initial

[87] Much of the below is taken from an interview I gave to the LSO. This can be found at (Morrish, 2018)

hazy sonic and conceptual impressions towards a piece that reflected the various strands of my compositional thinking at that time.

Traces is written for shellac discs (a precursor to the vinyl record), gramophones, stroh instruments, percussion, bass clarinet and sine waves. The piece is an exploration of the gramophone as a dream-object, a means of communicating with the past, experiencing the present, and preparing for the future. Sounds of raw electricity, industry and organic bodies are combined with mechanically amplified acoustic instruments (such as the stroh violin) to create a mosaic of memories, with the surface of the shellac discs both revealing and distorting the voices involved in the story of recorded sound.

Through prior compositional work, I had become increasingly drawn to the surface sound of sonic media – from the optical sound strip on film prints, to the brittle sound of shellac, vinyl and tape. I believe that there is great beauty to be found in the sound of these medial surfaces. They are unique expressions of the physical bodies involved in their manufacture – from the *laccifer lacca* insects which produce the raw shellac resin, to the mechanical lathes that etch sound onto disc.

SONOPTIC

Prior to working on *traces*, I wanted to explore possible medial strategies. I wrote a short instrumental study, entitled *Sonoptic,* in which the pops, cracks and static of the optical sound strip had been transcribed for a solo percussion performer playing prepared skins, with the optical sound being simultaneously transduced through the skin into the resonant chamber of the drum (fig. 51).

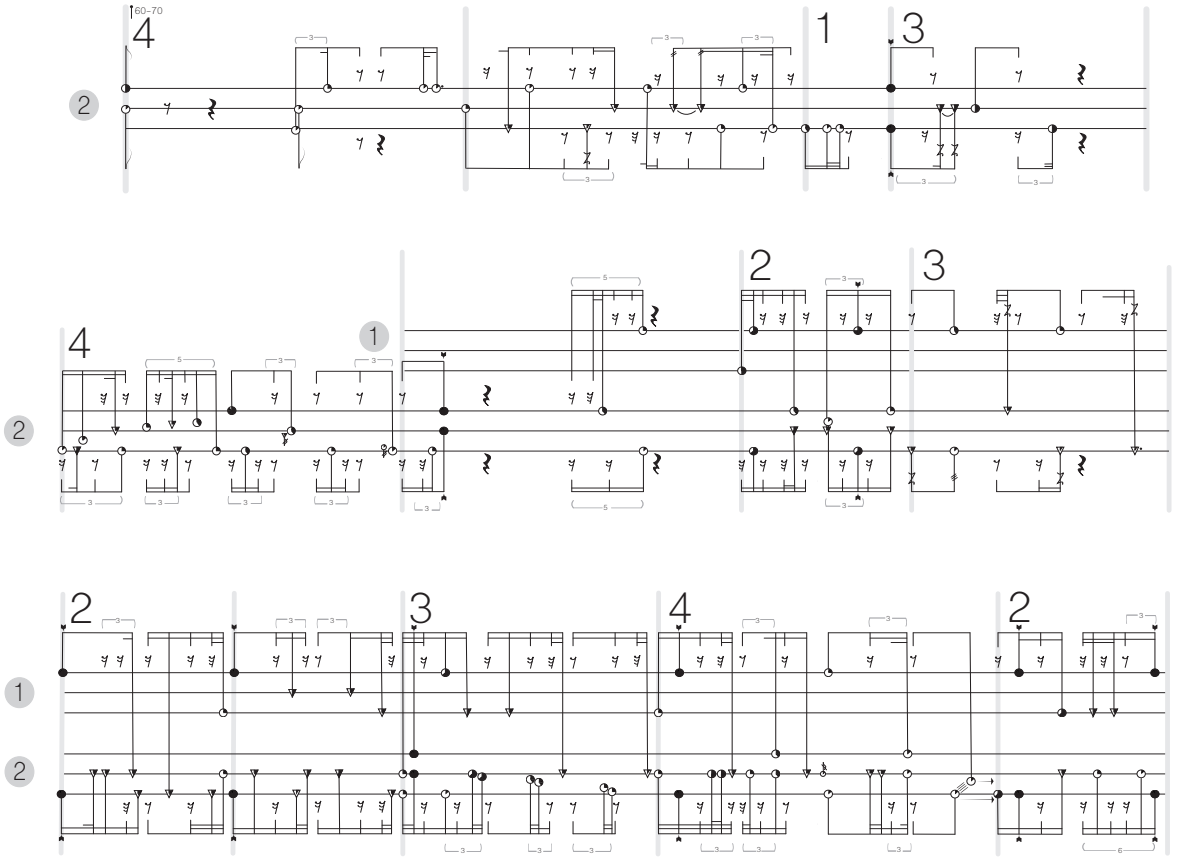


Figure 51 *Sonoptic* optical sound transcription, pg.1

Transducing the internal dynamics of these sounds to the bodies of other instruments is one possible medial strategy in which a compound, hybrid body synthesises the material qualities of two distinct components. This piece is yet to be performed, and perhaps as a result this approach has been left undeveloped, although I look forward to returning to it at a future date. The lack of a performance gave me an opportunity to question what I was looking to achieve by engaging with media; whether I was interested in the abstract rendering of a medial source, or the presentation and participation of this media within a performative frame. I came to realise that not only do these media open up worlds of dynamic sonic interiors, they also emanate temporalities and memories of their own. Their physicality exposes us to the brilliance and inventiveness of their mechanism. Moreover, subverting or supporting the associations that emerge from contact with them is a parameter that can be composed with. As a result, it became clear to me that I wanted to make pieces in which an expanded field of objects could be included in performative settings. For *traces*, I decided to take this thinking forward. I arrived at the shellac disc and the gramophone as objects of study for a number of reasons, including their sonic qualities, histories and choreography. I needed to excavate, to archaeologically delve into their matter and history.

From the outset, I wanted to make a distinction between shellac and vinyl, the gramophone and the turntable. For one, their material qualities are fundamentally different- shellac is organic and re-usable, although brittle and somewhat unwieldy to transport. Vinyl is made of petroleum and is manufactured for mass consumption. Secondly, gramophones are hand-cranked and need to be cared for and serviced in performance. The material qualities of shellac mean a heavier stylus is required, so record manipulation, as in turntable practices, would quickly degrade the surface and could break the crank. I relied heavily on the advice and expertise of Aleks Kolkowski in this, who operated the gramophones and was my collaborator on the project. Kolkowski has an encyclopaedic knowledge of early recording technologies and was generous enough to spend many hours listening to early recordings. I particularly loved hearing test oscillators and foley recordings from the first half of the 20th century, which recreate environmental sounds under studio conditions. Hearing these fascinating recordings proved to be a great source of inspiration for my own approach.

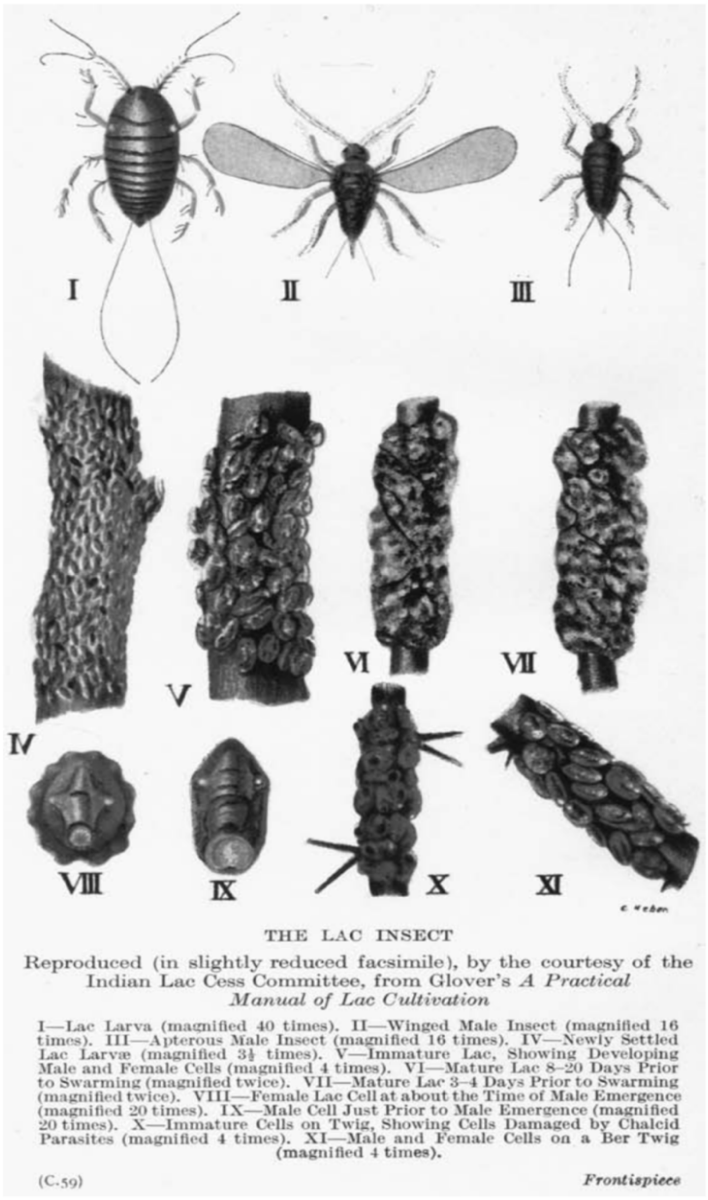
Figure 52 EMG gramophone, used in the performance of *traces*

Not only was I captivated by the content of these recordings, I noticed that the organic and fragile nature of shellac led to little sonic distance between its materiality and that which was etched onto it. I therefore decided to create my own shellac discs with the hope of melding the material (in this instance, understood as the content) and matter of these discs. I wanted to allow these sounds to rub alongside each other, to be overlaid and recombined. I wanted to create a piece in which overlapping windows of sounds would combine with little preconceived formal logic.

I became much less interested in a 'bound' work, and more so in an experience which is multi-dimensional, and that does not need clear boundaries or definition.

The content of the discs draws on a great variety of sound sources, from close mic'd recordings of insects, to the sounds of reels, cogs and industrial fans. Through researching the history of shellac, I happened upon Jacob Smith's reading of shellac discs as eco-sonic media. Smith helped me to become aware of the ways in which sonic goods circulate through infrastructural systems and how these systems depend on the nonhuman.[88] I wanted to give voice to the bodies involved throughout the manufacturing process of the shellac industry; from the lac insect to the sound of the lathes and the machinery that transport the discs to the listener (fig. 53). I was looking to attend to the stuff 'beneath, beyond and behind the boxes our media comes in'.[89] In working with the machines in this way, I present the gramophones as noise-producers, with raw and untreated environmental sound being combined within an ambient framework provided by the instrumental group and sine waves.

[88] (Smith, 2015) 14
[89] (Sterne, 2012) 11



THE LAC INSECT

Reproduced (in slightly reduced facsimile), by the courtesy of the Indian Lac Cess Committee, from Glover's *A Practical Manual of Lac Cultivation*

I—Lac Larva (magnified 40 times). II—Winged Male Insect (magnified 16 times). III—Apterous Male Insect (magnified 16 times). IV—Newly Settled Lac Larvæ (magnified 3½ times). V—Immature Lac, Showing Developing Male and Female Cells (magnified 4 times). VI—Mature Lac 8–20 Days Prior to Swarming (magnified twice). VII—Mature Lac 3–4 Days Prior to Swarming (magnified twice). VIII—Female Lac Cell at about the Time of Male Emergence (magnified 20 times). IX—Male Cell Just Prior to Male Emergence (magnified 20 times). X—Immature Cells on Twig, Showing Cells Damaged by Chalcid Parasites (magnified 4 times). XI—Male and Female Cells on a Ber Twig (magnified 4 times).

(C.59) *Frontispiece*

Figure 53 *Laccifer Lacca* insect, rep. pg. 18 (Smith, 2015)

My choice of instrumentation was also determined by the relationships held with shellac and the gramophone. Shellac is used on the polish of string instruments and under the pad of clarinets and so this seemed an appropriate place to start. Moreover, stroh string instruments had been built contemporaneously to more effectively directly their sound toward the recording horn of a gramophone, and it therefore seemed appropriate to include these in the instrumentarium of the piece

(fig. 54). Lastly, the needle of the gramophone had once been made of cacti needles and so the cactus was also included in the instrumental set-up alongside a varied collection of metals, pitched instruments and noise producers, which would serve to bridge the gap between the noisy material of the gramophones, and the clarity of their harmonic framing.

Figure 54 Stroh violin and cello in the performance used in *traces that remain*

THE HARMONY AND SINE WAVES OF *TRACES*

I found the unstable and noisy vitality of the gramophone sounds to be compelling, but there were limitations to their production. One side of a shellac disc is roughly five minutes in length, and I knew that I wanted a piece that could drift and ebb rather than exist in a fragmentary state. I wanted to create a world in which the grain

of these sounds would exist alongside materials of a radically different quality and to explore how relationships could be forged between them. I therefore began to search for pure sounds which do not decay and that stretch indefinitely through pitch and time space.

The sine wave is an interesting sonic phenomenon. Its lack of harmonic spectrum means that it has no parallel in the organic world. It is at one of end of a sliding scale of timbral complexity with the gramophone material being toward the other. I decided that the exploration of this scale could be a compositional strategy to be used throughout the piece, with the varied bodies involved in the performance being mutable points along a timbral line. Bodies would attempt to speak to one another, with their attempt to overcome difference only serving to reveal their fundamental materiality.

Having begun to explore the interiority of tone in the previous phase of research, I decided to utilise Tenney's arborescence technique to create three interpolated harmonic trees which would create a harmonic world produced by the sine waves. This also gave me a sense of how form might develop. I decided to proceed from their root (frequencies 38.891, 48.999, 61.735), up through their spectra to less clearly diatonic regions with more complex frequential relations and beatings, before

arriving back at the roots with enriched harmonic spectra. The ensemble would shift between indivisible relationships with the sines to the revealing of their instrumental mechanism, before moving toward a more enlivened rendering of the harmonic structure at the conclusion of the piece.

NOTATION

The sounds that I was exploring in *traces* did not flatten well to conventional notation. I wanted to create a personal graphic vocabulary to represent these. As a result, each part has a parametric stave in which density of events, volume and/or texture is indicated through a curved line. I used action notation strategies to indicate the choreography of instrumental movement and phrase structure. I created my own symbolic vocabulary for the sounds heard on the gramophones that represents both the morphology of the content, and my relationship to this content. When taken as a whole the score surface is much more indicative of a personal engagement with these sounds and is written in such a way to convey this to the performers (fig. 55).

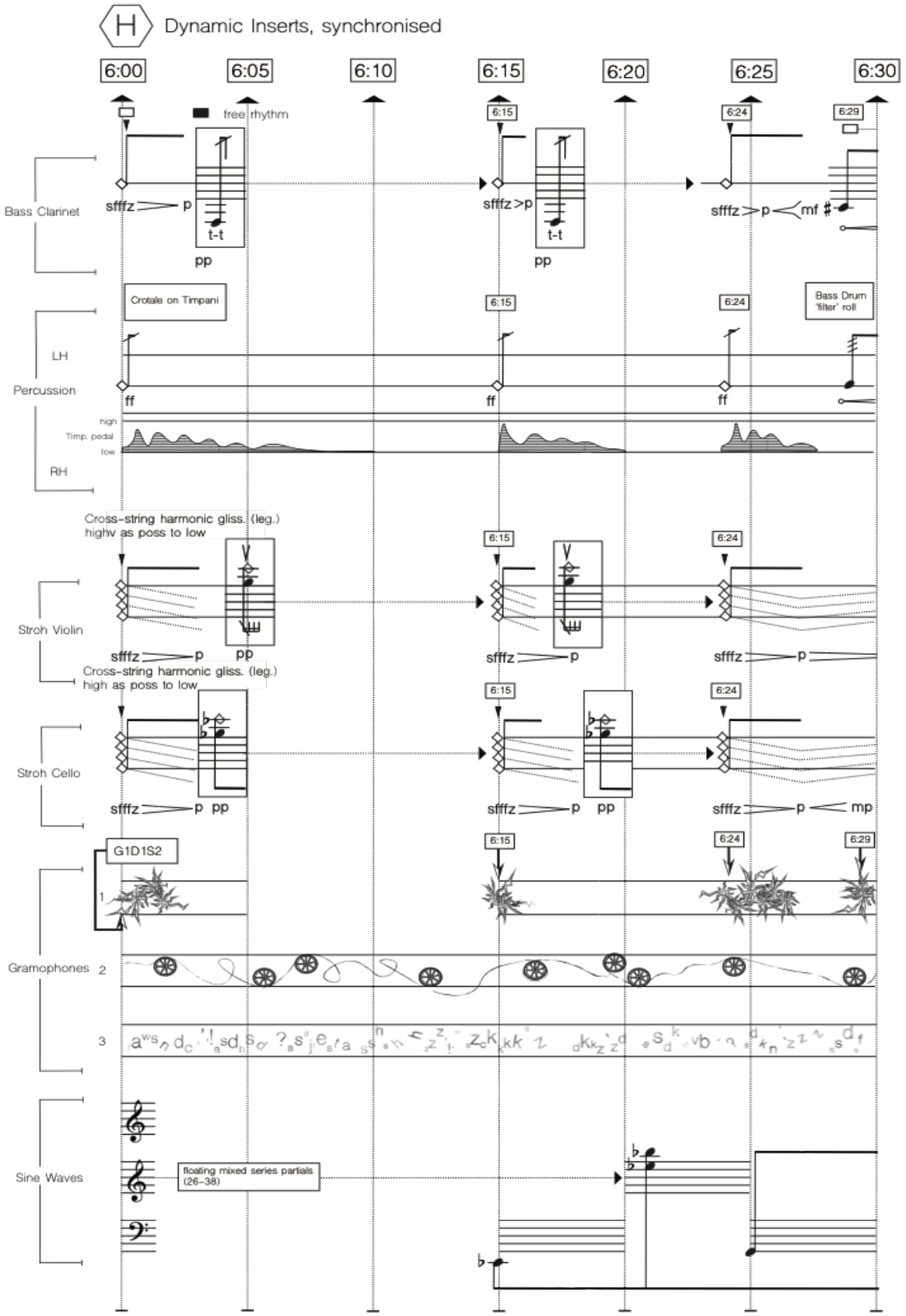
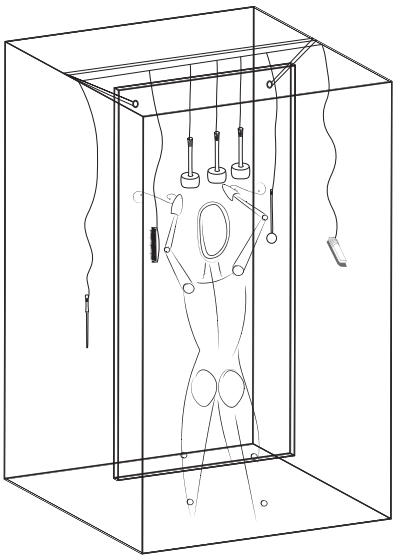


Figure 55 Parametric staves and graphic notation in *traces*, pg. 13

HARVARD

In the spring of 2018, I was thrilled to hear that I had been awarded the Mendelssohn Scholarship. In the August of 2018, I moved to the USA to become a fellow at the Harvard University Music Department for the 18–19 academic year under Professor Chaya Czernowin's supervision.

Relocating to Harvard came at an important time for me. It meant fresh challenge and input within an engaged community. It was an opportunity to re-collect and to discover new pathways. I was looking to continue my work with the emergent temporalities of media, the interiority of sounds, performative action and the score surface, but wanted to remain open to creative directions which could not have previously been foreseen. Czernowin's speculative approach, grounded in risk taking and questioning, was an inspiration. In the first few weeks of the winter semester, I started sketching out a new work for two performers, thundersheet and electronics which explored the intimate relationships between two performers and a sound surface that came in between them (fig. 56). The piece would be in open-form, using a morphological and action-based notation to indicate movement.



Divergent Experience A

Action:

Move the palms of your hand slowly across the surface of the sheet. Free, in a figure of 8.

Character:

Exploratory.

Dynamic:

Silent.

Duration:

.....drips

nothing can come between us

Figure 56 Unfinished sketch for *nothing can come between us*

Alongside this, I enrolled in Professor Hans Tutschku's course on fixed electronics. Professor Tutschku encourages a tactile approach to sound producers that result in electronic textures that have complex and evolving morphologies. Having relatively little experience with electronics in a concerted way prior to the course, I threw myself into the weekly tasks of composing short studies, with the view of creating a larger piece for the 40-speaker HYDRA system at the end of the semester. The piece for thundersheet remains unfinished, the electronics course challenged my understanding of sound materials, and proved to inalterably change the course of my compositional work.

STARFISH PRIME

The microphone is a mediality which opens up the world of sonic interiors. As an integral component of telephony, its lines extend beyond the walls of recording studios into the hand of each and every person. Working with microphones provides an opportunity to zoom-in to real and imaginary sound energies that cannot be accessed with human ears, ''the natural and unnatural world of small sounds.'[90] As in Zielinski, it is a medium which exposes conditional, and natural occurring phenomena such as electromagnetic charges and conduction, to human perception.

I began by researching media which are specifically designed to attune to the electromagnetic field. Douglas Kahn's *Earth Sound, Earth Signal* opened my ears to work in this field by Cage, Lucier, Oliveros, Mumma and others.[91] What particularly excited me was Kahn's description of Thomas Watson's encounter with natural radio when first testing the newly created telephone. Natural radio is a form of VLF (very low frequency) radio, electromagnetic waves which are produced by the electrostatic charge of lightning. The path of these waves extends into outer space, before reflecting back through the ionosphere. For the physicist Millet Morgan,

[90] (Khan, 2013) 34
[91] (Khan, 2013) 8

> The excitation of the ionosphere by a bolt of lightning is pretty much like hitting the ionosphere with a hammer, exciting it across the full frequency spectrum. You can hear lightning crashes on the very high frequencies and the usual communication frequencies in the broadcast band; and low frequencies where aircraft warning beacons operate; and even at audio frequencies such as these, which produce the swishes or whistlers.[92]

VLF range from 3–30 Khz and so can be heard by human ears with the appropriate receiver. Watson began by listening to these sounds inside the lines of telecommunication, rather than the sounds of the person picking up the receiver.[93] As Kahn describes,

> Some of the natural sounds that Watson and others heard in the telephone were perceived as musical, especially short sliding tones and whistling glissandi. Indeed, the term *musical atmospherics* later became common in scientific quarters, and researchers in the early 1930s described atmospherics along a continuum of *musical, quasi-musical,* and *non-musical.* In the musical and artistic avant-garde, the *quasi* middle ground was negotiated primarily in terms of an accommodation of *noise,* first

[92] (Khan, 2013) Millet Morgan 2018
[93] (Khan, 2013) 6

> formalized in Italian Futurist Luigi Russolo's *Art of Noises* manifesto from 1913 and echoed in John Cage's call in "For More New Sounds" in 1942. During the 1920s and 1930s, the science of whistlers and the musical avant-garde shared a similar tolerance and delectation for the plasticity of what was and what was not musical sound; and it can be said that Watson too was listening to the types of noises and odd sounds that would become amenable to the avant-garde almost four decades later.[94]

What can be heard in the above is a weighing of sounds along a scale of expressivity. In other words, it is an attempt to come to terms with pattern recognition in chaotic auditory data, with noisy and earthly lines of communication transmitting unearthly 'musical' signals. This result is an acoustic territory which is full of energy, highly complex and often non-linear. When attending to this, moments of perceptual grouping fleetingly occur. Constellations of sounds aggregate in an uncanny perceiving of patterns that result from an engagement with the nonhuman. Furthermore, the *atmospherics* of the medium are being attended to. Telephony is no longer merely a technical means of communication but also a conductor for

[94] (Khan, 2013) 6,7

aesthetic events. It is a medium through which someone may be listening, but not always one in which someone is sending.[95]

As a result, I became interested in exploring natural radio as a sound source for my acousmatic piece. I also wanted to explore further usages of radio to transmit non-linguistic, encoded or abstract sound. Through this, I discovered the Conet Project [96] which collects recordings of number radio stations. Number stations, which have been in use since the WW1, transmit formatted number sequences and are addressed to intelligence officers. My first encounter with these was through Jean Cocteau's *Orphée*, in which the poet Orphée discovers a world within each transmission, trailing the unknown through the strings of numbers (fig. 57).[97] They also spoke to me on a formal front, and were included as conceptually derived markers which stand in relief to the unruly and nonlinear aggregations of the natural radio.

[95] (Khan, 2013) 1
[96] (htt)
[97] (Cocteau, 1950)

Figure 57 Orphée listening to the poetry of number radio transmissions in Jean Cocteau's *Orphée* (Cocteau, 1950)

SERGE MODULAR SYNTHESIZER SYSTEM

In the studio in which I was undertaking this work sat a number of analogue devices which I was unfamiliar with. Whilst working on the piece, I felt the pull of the mass of cables sprawling wildly amongst rows of dials and switches. I was looking for further sounds which were the result of electricity and so I began to explore the sounds that I could draw out of them.

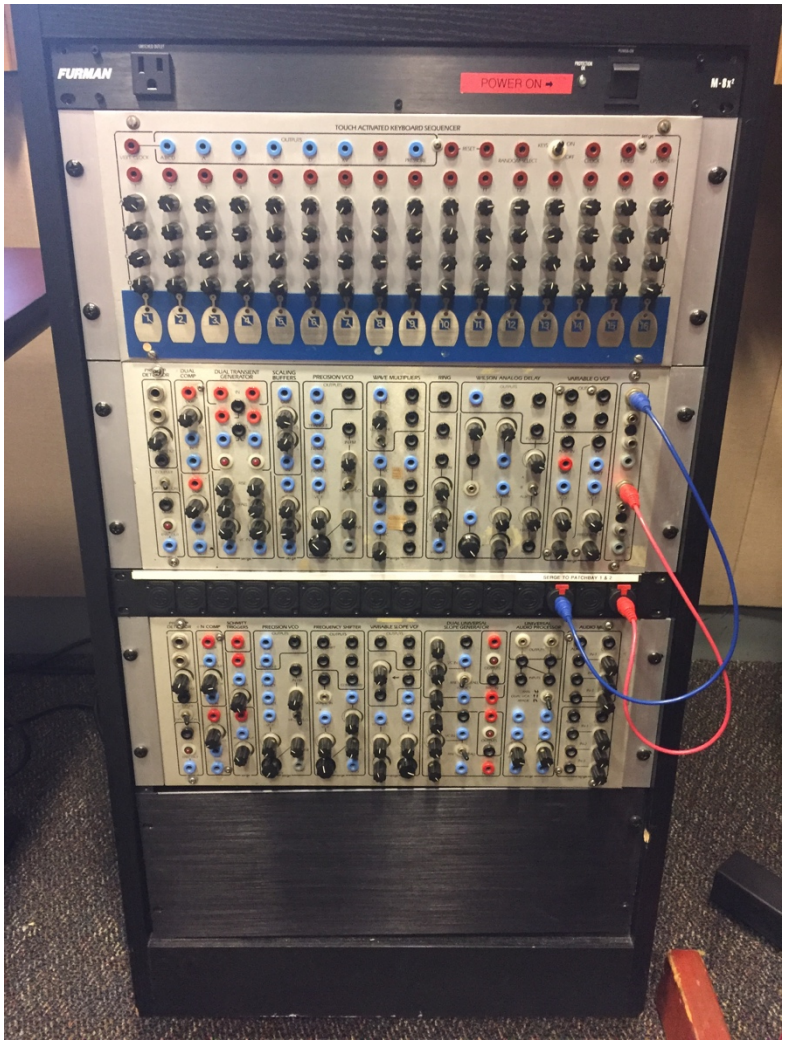


Figure 58 Serge Modular Synthesizer System at Harvard University

This was my first introduction to the Serge Modular Synthesizer System (fig. 58), installed by the composer and electronic instrument builder Serge Tcherepnin (who was himself a student at Harvard). It was the material fallibility of the Serge that I found so compelling. The heat of the circuitry, the age of the machine, the discrepancies in design and the enchainment of component after component means that noise is an inevitable product of the system. Its fallibility produces an atmosphere of movement; the humming and hissing of electrical signal as it passes through

patch cords and bays. To produce a sound through the Serge (at least in untrained hands) brings with it the risk of both failure and overloading the system. Stability is the design intention and yet it seemed to be an impossibility. The signal from tone generators waver uncertainly as they undergo micro-evolutions in pitch contour, whilst the damage to the instrument that it has accrued over years of usage leads to distortion in sound when knobs are turned, or switchers are flicked. The sound produced is never clean; there is an audible noise floor that remains in counterpoint to any tone that is generated. As I experimented with the instrument freely, I became aware of the power that it contained. I could feel its low frequencies shake my bodily organs, and its high frequencies ringing in my ears. The ability to work haptically with sound transformations meant that I could produce sounds that had an inner life, a human quality, and were not mechanically treated through automation. Every sound had a grain which I had found to be missing from previously experimenting with digital electronic media.

Through the Serge, the analogue became an increasing area of interest, with the very qualities that digital culture seeks to surpass; instability, fragility and impermanence, becoming valued performative attributes. I began experimenting with no-input mixing (in which the output of a channel is directed into the input of another, creating feedback loops) and continued my work with radio to find sounds

that I found to be expressive (fig. 59). The interfaces of these instruments are unpredictable; you are entering into dialogue with forces that are beyond your control. Working with them means attuning to the network of possibilities in which you have become a node.

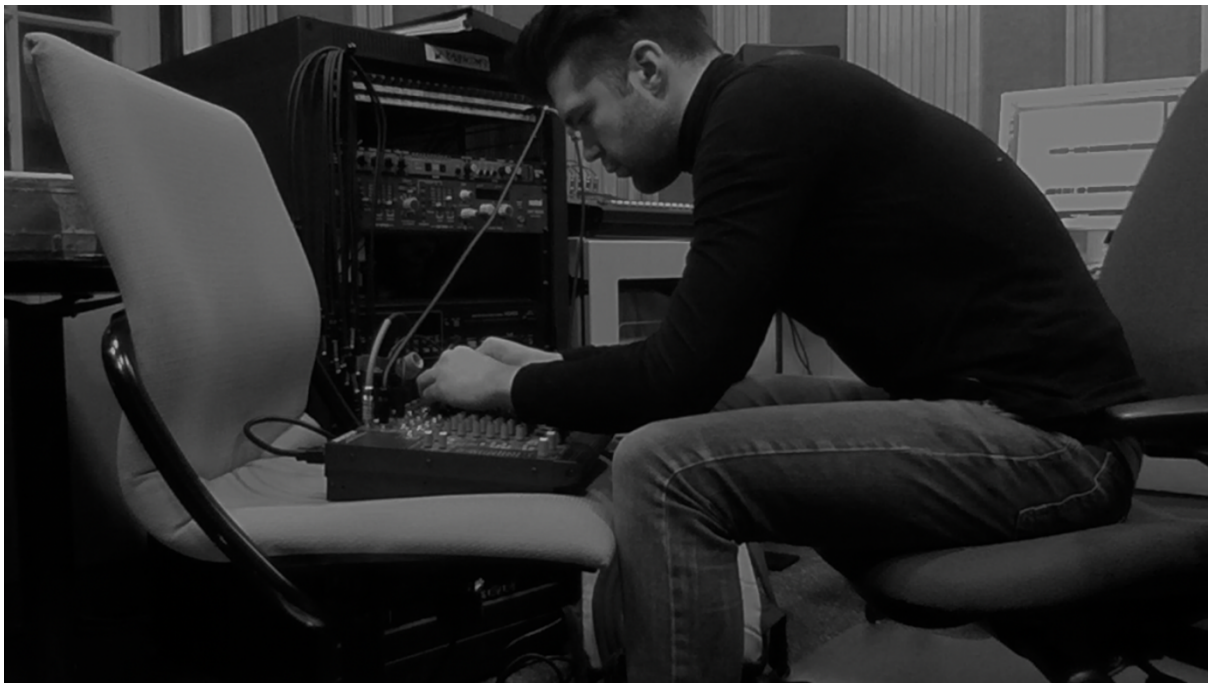


Figure 59 Exploring no-input mixing in the Harvard University HUSEAC studios

FRAGILE THRESHOLDS

Following on from producing and gathering sounds from the Serge, natural radio, number stations, industrial field recordings and my own voice, I catalogued that which had been produced with the intention of weighing their qualities in relation to one another. I was looking to shape these sounds within each section rather than imposing human gesturality upon them, as Czernowin has stated, to discover 'the

ways things unfold when they move purely on their own terms bringing their inherent potentials into realization'.[98]

I began by listening for sounds that were at the point of rupture. The fragile threshold between coloured noise and a mass of distorted sound became a line which I was interested in stepping backward and forward over. I used a variety of software to analyse the spectral content of the sounds (Audiosculpt, Spear, Sonic Visualiser), to either leaven the density of an acoustic event, or to hear it in full volume (using Izotope RX7). My role in this was to become-with this material, to bring my sense of musicality in line within an unfolding mesh of nonhuman sounds without compromising the qualities that I was so drawn to initially. Any digital manipulation of the sound post-production would have to be minimal and inaudible. This called for continually listening and reappraising, as each decision unearths new possible paths of discovery. This technique is very much akin to that used in *Life of Lines II*, in which a dense field of information undergoes processes of erasure. What remains is the grain and atmospherics of the media through which sound is being produced.

[98] (Czernowin, n.d.)

Formally, *Starfish* is made of the dramatic juxtaposing of panels of sound which are radically disjunct from one another in content and quality, as seen in the waveform in fig. 60:

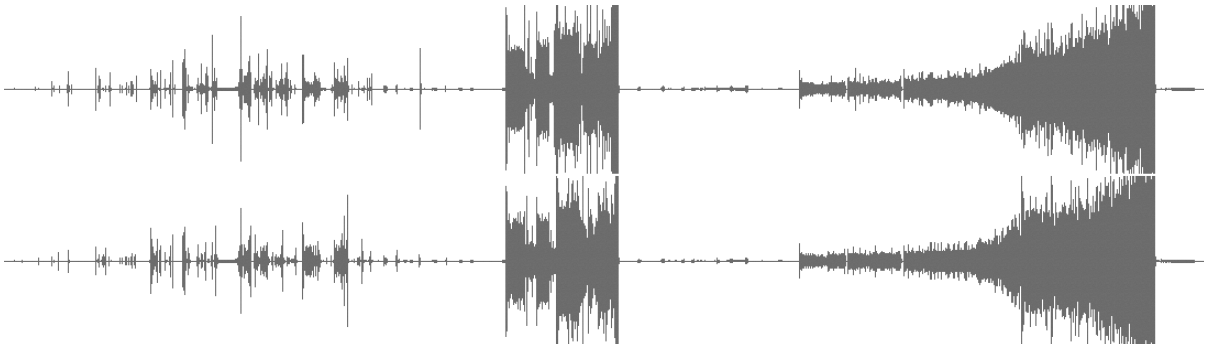


Figure 60 *Starfish Prime*, waveform demonstrating formal panels

As represented in the spectrogram of fig. 61, the full range of human hearing is employed, through the use of frequencies from 20hz to over 16,000hz, at high and low amplitude.

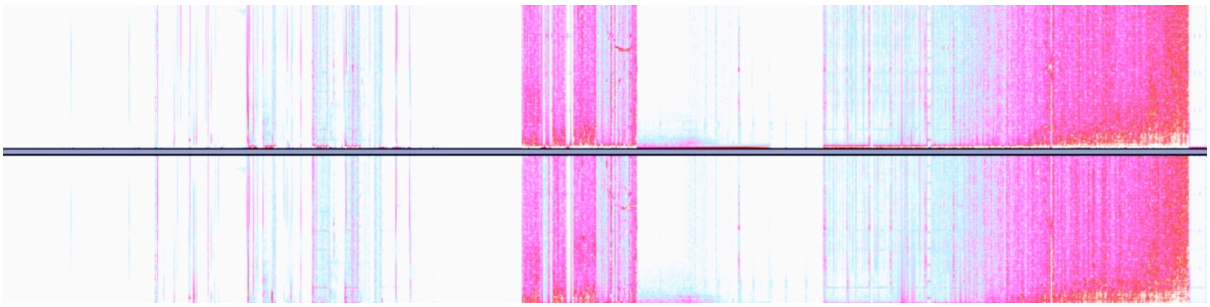


Figure 61 *Starfish Prime*, spectogram

I was looking to highlight the materiality of our auditory apparatus and excite the ear in such a way that we become aware of our embodiment. In performance, the

low frequencies could be felt in the body, while the high, quiet frequencies traced lines through pitch space that were barely audible.

The 40 speaker HYDRA system was used to diffuse these sounds in space (fig. 62). The system is made up of concentric rings of speakers which differ in size and quality. With speakers positioned both near and far in space, sounds could be placed proximally or distally, and move rapidly through spatial positions. Through the diffusion of sound, a variety of spatial situations could be created, from the intimate to the totally immersive. In my diffusion of *Starfish*, I used this to support the material differences of each panel to create a multidimensional listening experience in which the audience were placed in the centre of an ever-shifting electric soundscape. This was controlled from the mixing desk and performed in real time.

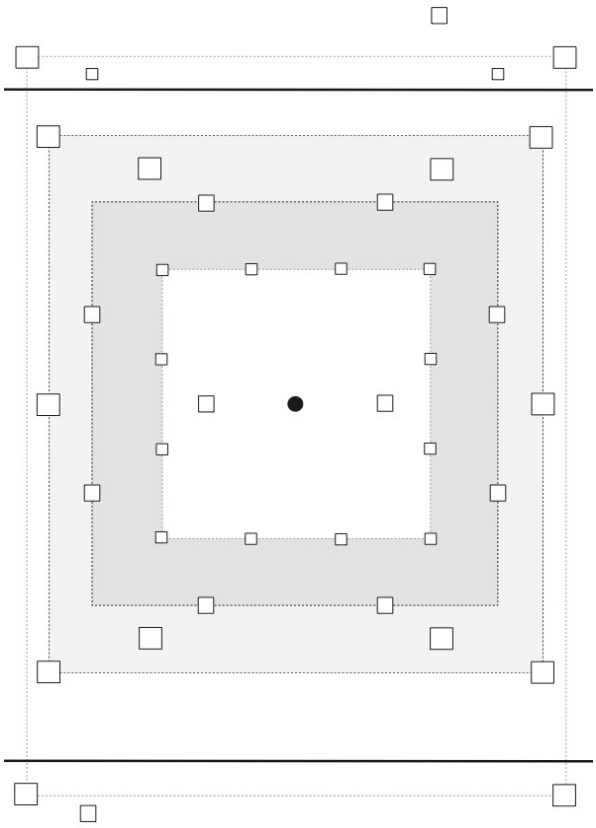


Figure 62 possible configuration for HYDRA system

YOKOBIT

As a result of making *Starfish*, I had produced a corpus of sounds which had been catalogued roughly in accordance to their morphology. Sounds were grouped by the quality of their attack, continuant, decay and energetic profile. As a resource, the raw and untreated files presented a huge range of possible applications and I was determined to explore this further in future work.

In the spring of 2019, I was selected by ICE, the Los Angeles Philharmonic, Ashley Fure and Andrew Norman to participate in their National Composers Intensive program. A select group of composers were commissioned by the LA Phil Association to write a piece to be performed by ICE at Walt Disney Hall later that year.

Following on from early conversations with Ross Karre and Levy Lorenzo (ICE's co-director and electronic designer respectively), it became clear to me that the members of ICE were looking for progressive work that would challenge the ensemble. Having built a library of sounds through *Starfish*, I was interested in continuing to expand this, and to explore how these sounds might be used in the

context of live performers. *Starfish* had tipped towards the noise end of the tone–noise continuum, and I was interested in traversing this to include more clearly harmonic materials based of frequency relationships (as in Tenney). Finding meaningful relationships between these sounds and how they were to be produced by live performers was a central concern for the work to be made.

Moreover, I wanted to find a means of creating a formal architecture whose proportions were less rationally derived. Whilst working with unruly nonhuman and electric sounds in *Starfish* had led me away from discrete human gesturality, the form was still rigorously partitioned according to prior design. In the case of *Starfish*, this served the idea of creating distinct timbral panels of sound, but I was hoping that the new piece would proceed formally in a looser and more organic manner.

ENCODING YOKO ONO AND IRRATIONAL PROPORTIONS

To create a more irrational formal structure, I decided to deduce formal proportions from another media, extracting its metadata for use in a musical frame. At the time, I was very much drawn to Yoko Ono's instructional pieces collected in *Grapefruit*.[99] I loved the way in which Ono opens up worlds of poetic discovery through a series

[99] (Ono, 2000)

of brief instructions. The pieces ask the reader to sensuously engage with the world through sound, to contemplate the environment and to engage with it through the body. The piece that I chose to work on was the third Piece for Orchestra (fig. 63):[100]

A PIECE FOR ORCHESTRA

Count all the stars of that night by heart.
The piece ends when all the orchestra members finish counting the stars, or when it dawns.
This can be done with windows instead of stars.

1962 summer

Figure 63 *A Piece for Orchestra* rep. *Grapefruit* (Ono, 2000)

Each letter of the text was assigned a binary code, with the integers summed to produce a total for each line (fig. 64):

A		P	I	E	C	E		
01000001	00100000	01010000	01001001	01000101	01000011	01000101	00100000	
F	O	R		I	C	E		
01000110	01001111	01010010	00100000	01001001	01000011	01000101		39

Figure 64 binary code for text, *yokobit*

[100] (Ono, 2000) 7

With the piece's duration being limited to six minutes, I could then deduce formal proportions for the length of each section from the sum of each line (fig. 65):

39:116:30: 89:143: 55: 139: 36: 43 total: 690

			Sect. No.
39	690	0.0565217	1
116	690	0.1681159	2
30	690	0.0434783	3
89	690	0.1289855	4
143	690	0.2072464	5
55	90	0.6111111	6
139	690	0.2014493	7
36	690	0.0521739	8
43	690	0.0623188	9

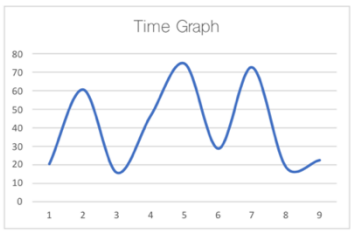
Figure 65 *yokobit* formal proportions derived from *Piece for Orchestra*

I the used these proportions to calculate an irrational structuring of global sections and periods, alongside the amount of tempo deviation from clock time permissible within each (fig. 66):

6 Mins= 360

360 0=0, 40=1, 80=2

prop.	total value	total duration	Perc. Prop	**Sec. Prop.**	Sec. Round	Sect. Lett.	(Mean of v.r.)	V. for Temp. dev.
39	690	360	0.056522	**20.34783**	20	A	40	0.5
116	690	360	0.168116	**60.52174**	61	B	40	1.525
30	690	360	0.043478	**15.65217**	16	C	40	0.4
89	690	360	0.128986	**46.43478**	46	D	40	1.15
143	690	360	0.207246	**74.6087**	75	E	40	1.875
55	690	360	0.07971	**28.69565**	29	F	40	0.725
139	690	360	0.201449	**72.52174**	73	G	40	1.825
36	690	360	0.052174	**18.78261**	19	H	40	0.475
43	690	360	0.062319	**22.43478**	22	I	40	0.55
					361			



SECTION A

prop.	total value	total duration	Perc. Prop	**Sec. Prop.**	Sec. Round	Sect. Lett.
39	690	20.347826	0.056522	**1.150095**	1	AA
116	690	20.347826	0.168116	**3.420794**	3	AB
30	690	20.347826	0.043478	**0.884688**	1	AC
89	690	20.347826	0.128986	**2.624575**	3	AD
143	690	20.347826	0.207246	**4.217013**	4	AE
55	690	20.347826	0.07971	**1.621928**	2	AF
139	690	20.347826	0.201449	**4.099055**	4	AG
36	690	20.347826	0.052174	**1.061626**	1	AH
43	690	20.347826	0.062319	**1.268053**	1	AI
					20	

Figure 66 Global proportions, tempo deviation and periods in Section A of *yokobit*

I then assigned each instrument three lines of pitch information, with sonic events being nodes placed along each line. As a result of the working included above, the degree of tempo variation of each line was much wilder and less directional than my previous use of this technique (fig. 67), in which growth patterns had been intuitively shaped. This was a problem that I had encountered in previous pieces and was resolved to overcome; where the density of events moved too predictably through processes of accretion or dissipation. In *yokobit*, I was looking to create an aggregate of points more akin to the overlaying of natural radio in *Starfish*, where the density of events was sporadic, and the directionality of these events would not be perceivable in the final piece.

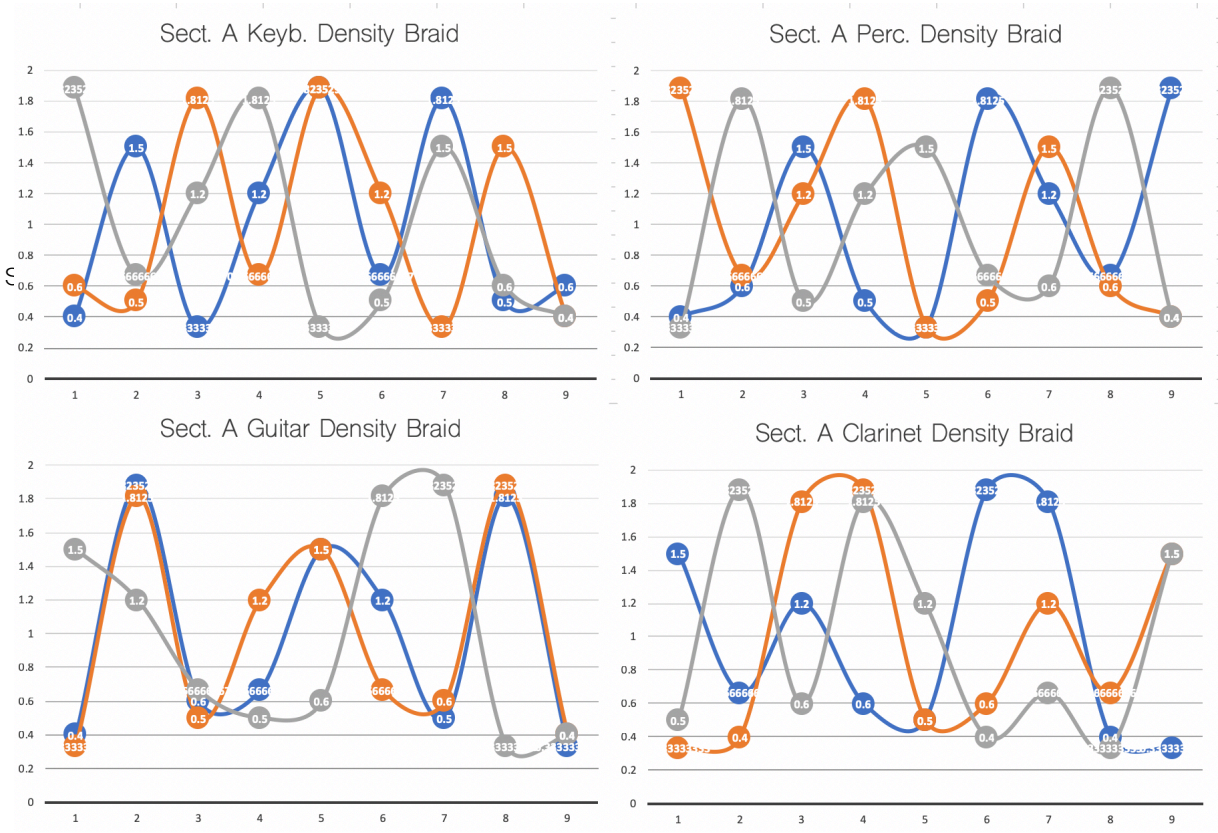


Figure 67 nonlinear tempi deviation, section A, *yokobit*

The result of all of this was a hyperdense cloud of points akin to black midi (fig. 68).[101] As in the work undertaken in the first phase of my research, this cloud of points was then subject to further stages of intervention including 'scrubbing' through material in time; using extreme global tempo deviations in the form of accelerandi and ritardandi to move between proportionally derived tempo markings. I then 'performed' these in software, with my performance being converted into a timecode which would place events within a spacetime structure.

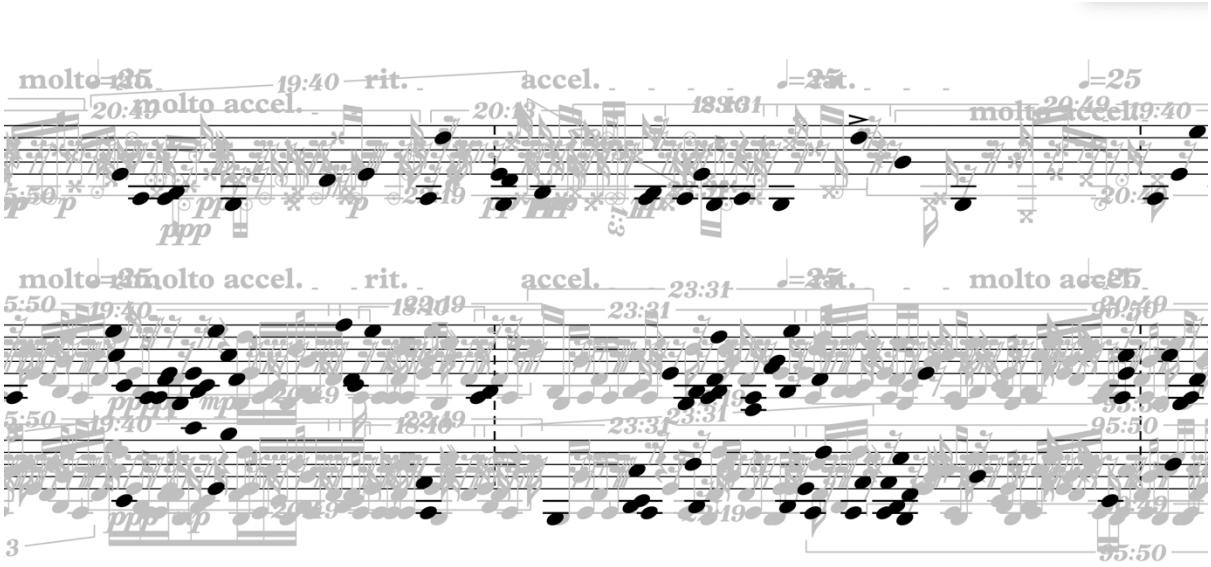


Figure 68 A first pass at erasure in keyboard and percussion parts of *yokobit*

[101] 'black midi' is a musical genre/Youtube phenomenon in which hyper-dense midi files are created for audio-visual effect. Representative examples can be found on Jason Nguyen's Youtube channel: https://www.youtube.com/user/gingeas

I then subjected these results processes of erasure. My initial passes at this reduced the number of events by approximately 75% and resulted in streams of material like those found in fig. 69:

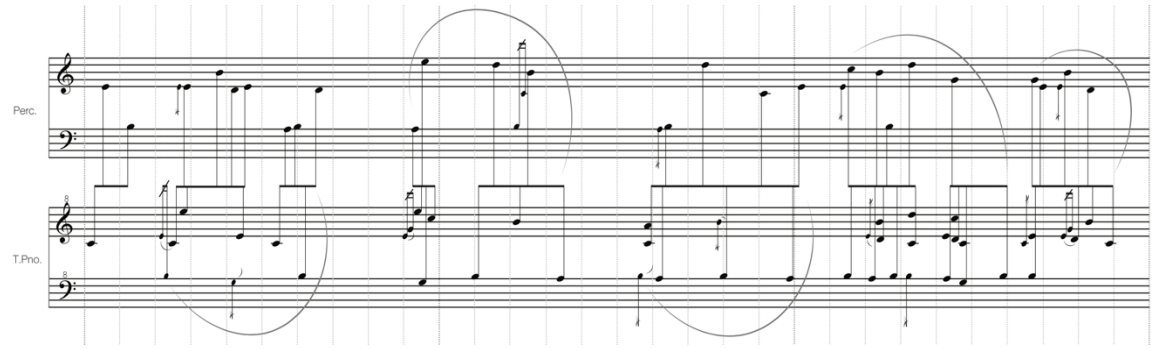


Figure 69 Initial sketch after erasure, keyboard and piano, *yokobit*

Due to the density of events, each process of erasure revealed new constellations; points that I felt connected to other points. I could express my sense of gesture and line within an underlying force field of temporal attraction and repulsion. I spent a great deal of time trying out different combinations. The possibilities were limitless; new musical ideas were revealed with each attempt. By the end of this period of experimentation, I was somewhat exhausted by trying to find a definitive rendering of the structure. I decided to see what would happen if I added a further stage of intervention; using virtual instruments to perform the material which I would then treat as a sound file to be cracked open, splintered and reversed, to glitch the process in its entirety. Through this, I found sounds that resonated with me and that bore little trace of the underlying processes which I had patiently worked through. I

decided to use the results as the spine of the piece, a glitching memory of an encoding process which had been stitched together anew (fig. 70). I overlaid multiple versions of this material which had been resynthesized, transposed, stretched and distorted. I then granulated this sound by hand, cutting it roughly into small segments which I would then distribute stereophonically between two parts to create intricately woven sound patterns. This is akin to the micromontage techniques of Horacio Vaggione and Curtis Roads, whose use a variety of granulation procedures (from the intuitive to the scripted) create complex and intricate sonic aggregates.

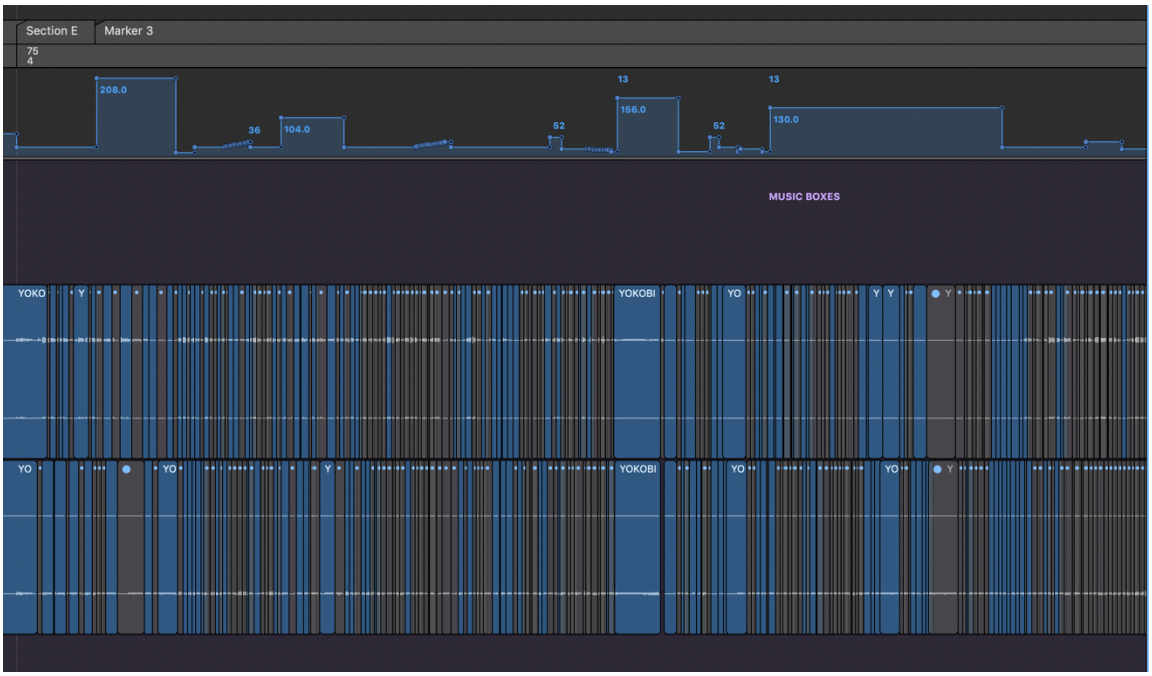


Figure 70 Hand-cut granulation of *yokobit* material

DEGRADE BOXES IN YOKOBIT

The work undertaken thus far had resulted in granular sonic material to be used in some way. However, I was very keen for the live performers to interact with the electronics haptically, rather than have a fixed electronics part outside of the performable material. Moreover, working with the HYDRA system to diffuse *Starfish* had demonstrated to me the power of spatial locality and the way in which we perceive the quality of a sound differently depending on the position of the source and the media through which it is being transmitted. As a result, I decided to create a miniature stereo speaker system, with each speaker enclosed within a cigar box (fig. 71). The lids of the boxes would filter the sounds being made. This would collapse the distance between the electronic and the haptic and would result in an intimate choreography between two members of the ensemble.

Figure 71 *yokobit* 'degrade' boxes

I also placed a music stand light within each box, to create a kind of miniature portal, out of which sound and light would escape. The piece would be performed in near darkness so that the light emitted would illuminate the faces of the performers to create an intimate visual and sonic situation.

CIRCUIT SNIFFERS

I then returned to the corpus of electric sounds that I had produced for *Starfish*. As in the degrade boxes, I was keen for electric sounds to be produced live and so decided to create media of my own which would listen to the sound of electricity in performance. The result was the fabrication of circuit sniffers; electromagnetic coils which interact with the electromagnetic field of devices and listen-in to the movement of electricity across components of their circuitry (fig. 72).

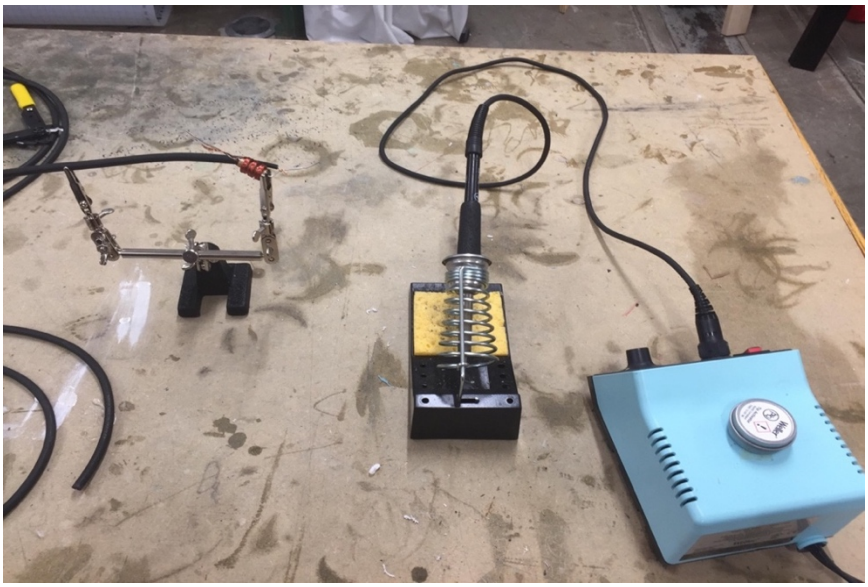


Figure 72 Fabricating circuit sniffers for *yokobit*

The distance between the electromagnetic field of the electronic device and the coil of the circuit sniffer impacts the amplitude. Similarly, the position of the coil in relation to the device impacts the type of sound being 'sniffed'. The results are highly diverse, from unstable electric hums to pixelated static. This informed the type of performative engagement required to produce the sounds I was looking for, with the proximity of the circuit sniffer to the device needing to be choreographed through notation (fig. 73).

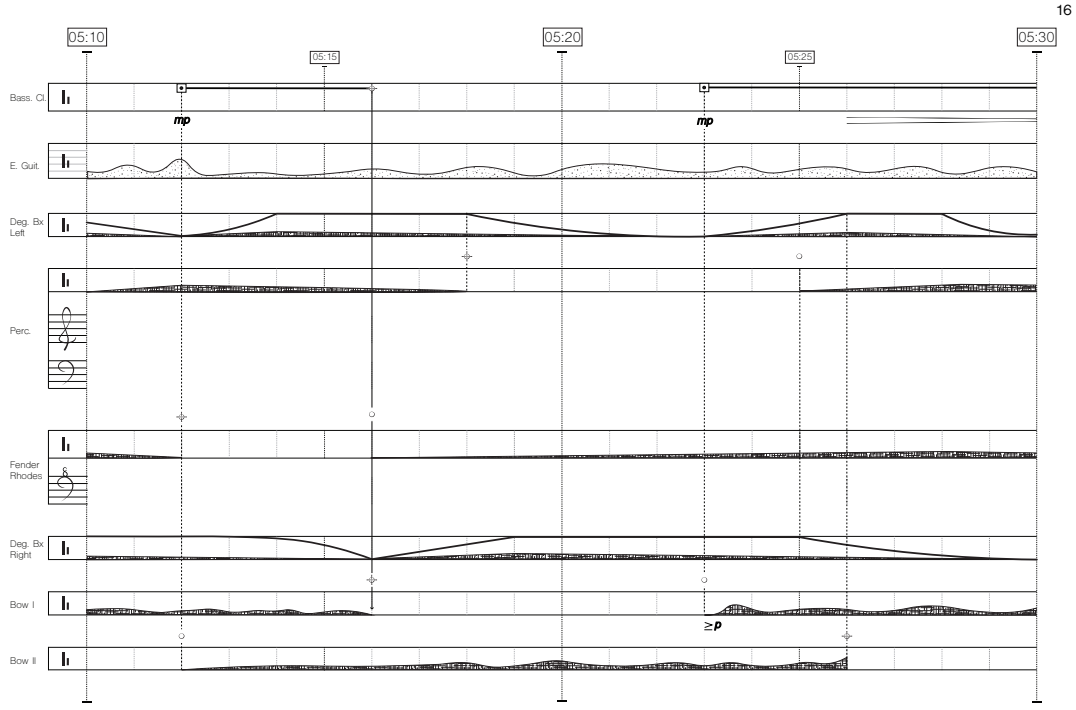


Figure 73 Example of circuit sniffer notation, pg. 16 *yokobit*

AMPLIFICATION AND TIMBRE

Alongside the electricity of the circuit sniffers and the glitched fabric of the degrade boxes, I wanted to utilize sounds that were akin to the morphological qualities of

that which I was hearing. I was looking to create a synthesized global texture in which the distance between electronic and acoustic territories would collapse. I experimented with contact microphones and amplification to produce electronic-like sounds on instrumental bodies. This resulted in a number of new performance techniques, for example, the electric guitar being used as an amplification surface for the granular sound of a metal sponge, the string instruments using wooden kebab skewers to brush the surface of the hairs of the bow to create an unstable white noise sound and the bass clarinet being amplified and pitch shifted to produce air sounds of various spectral densities which melt into the electronic sound world produced through the combination of all of the above.

A DISTENDED SONG

Following on from this, I returned to the initial encoded material. My prior working with this had resulted in the overlaying of lines of material, with constellations of events emerging through their interaction. These were still too dense; despite the processes of erasure I had undertaken to reduce them. I therefore decided to be even more radical in this, dilating the number of events down to a melodic line, a song, that would be shared among the instruments and sung over the course of the piece (fig. 74). The attacks of these tones would be extended by sine and

square waves, tuned microtonally around the central frequencies using Tenney's arborescence technique. The result is a fragile braid of acoustic and electric sound, melted together to form an ambient world that is constantly degrading and at the point of collapse.

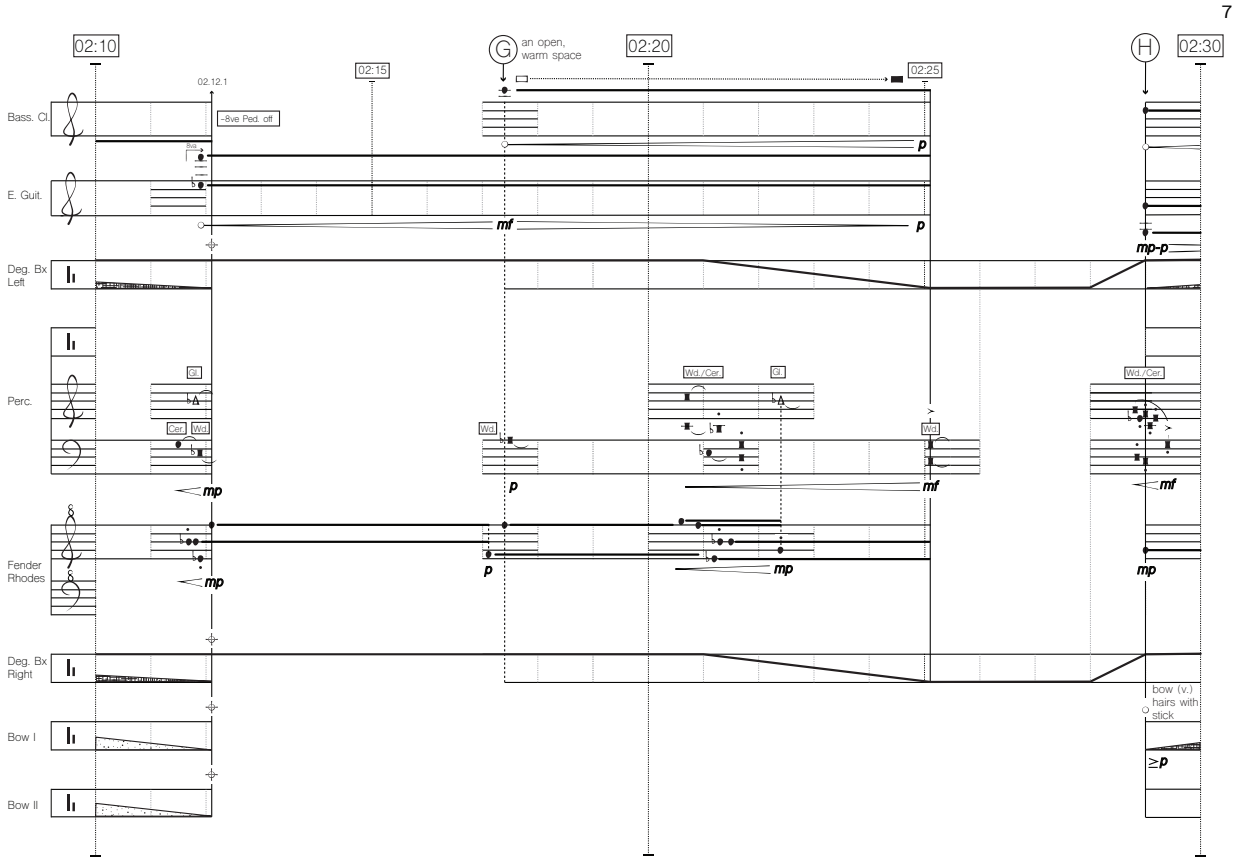


Figure 74 hocketed melody, threaded through instruments, pg. 7, *yokobit*

ANGEL | ANIMAL

In the autumn of 2018, I was delighted to discover that *traces* had been nominated for the Gaudeamus Award 2019, with the nominations being adjudicated by Yannis Kyriakides, Clara Iannotta and Gerhard Stäbler. With this came the opportunity to be featured at Gaudeamus Muziekweek, receiving performances of three pieces, including a newly commissioned work. I was told that the piece was to be of approximately ten minutes duration and should include instruments drawn from Catchpenny's mixed chamber ensemble.

I was keen to continue my (an)archaeological explorations of sonic media in the new piece alongside finding means of collapsing the distance between acoustic and electronic domains. Having begun to investigate phonography as a mediality which stores nonhuman bodies, I wanted to return to this; to regather the loose strands of previous thoughts to be braided together in a new work.

There are a number of things that continue to fascinate me about this topic, not least, the ways in which media make immaterial presences audible. They render time as an available compositional material and give voice to bodies distributed vastly in time and space. I decided that the new piece would be an exploration of the atmospherics and spectrality of sonic media; the ways in which sound surfaces

render time as an audible materiality and how this media is haunted by the presence of an audible past. I wanted to engage with this on both a personal and conceptual level, to gather up my own experiences within an enmeshed compositional methodology.

Having become increasingly engaged with electronics over the course of the last few pieces, I began by taking stock of my working processes; appraising where my work was situated within the broader context of the medium.

The sounds that I was most interested in are the audible result of energetic forces and that emerge out of tactile engagements with the unruly behaviour of analogue devices, rather than neat digital production techniques and virtual instruments. To this end, I am fascinated the work of Eliane Radigue, Thomas Ankersmit, Toshamaru Nakamura and Ralph Steinbruchel. My pre-compositional working, which could hypothetically be scripted and produced through programming environments such as OpenMusic or Pure Data, was being undertaken by hand. I was producing scores in Adobe Illustrator, which meant a blank page with no in-built database of symbols, with every mark made being of my own choosing.

These approaches are laborious and slow down the compositional process to the point at which the hand is implicated at every stage. Mistakes are made, processes

are bent out of shape, idiosyncratic decisions are etched into the very fabric of the material. For me, this has a number of benefits. Interventions can be made at any point; sounds are the result of performances in the studio and notational strategies are not determined by software engineers. I was learning to work with that which I could produce myself, rather than relying on the work of others at any stage of the process.

On the one hand, this can be viewed as the gradual developing of a practice to create work with tools that were within my reach. On the other, what can be read between the lines is a distrust of concepts of technology that position the digital at the apex of technological progress and imagination. Digital production techniques reduce complex waves to a series of zeros and ones, cloud computing, whilst marketed as clean and lightweight, takes up a huge amount of physical space and resources, and the components of digital media cannot be recycled for further usage. The digital was once marked as the future. in fact, it betrays it. Thinking about what can be found after this future, was to guide my subsequent work.

HAUNTOLOGY

This led me to the work of Mark Fisher, the cultural theorist and music journalist known widely as K-Punk through a blog active during the early 2000s. Fisher reframed Jacques Derrida's concept of hauntology to describe a cultural impasse in which it was impossible to imagine a radically different world. This was due to the failure of the future of modernity to arrive. For Fisher, the obsessive foregrounding of technological artifacts and the paraphernalia of the contemporary in art did little to disguise the disappearance of formal innovation and new kinds of sensory experience.[102] It was the resurgence of a kind of cultural conservatism whose roots were in the consumer culture of late capitalism. Music was the embodiment of this inertia; the listeners of the 1960's could not have anticipated the rave scene of the 1980's, but the work produced in the 21st century was just as likely to have been made at the tail end of the 20th. While the electronic music of the mid 20th century- Schaeffer, Stockhausen, the BBC Radiophonic Workshop, Kraftwerk and others- had been at the cutting edge of musical innovation, it had now succumbed to self-reference and inertia,

[102] (Fisher, 2012) 18

> 'If electronic music was ''futuristic,'' it was in the same sense that fonts are ''gothic''—the futuristic now connoted a settled set of concepts, affects, and associations.'[103]

As Fisher describes, critics in the early 2000s were prompted to reach for the concept of 'hauntology' as a way of framing the work of artists, such as The Caretaker, those on the Ghost Box Label and Burial, whose work confronted this cultural impasse.[104] From the crackle of vinyl, the subjecting of 30's pop to distortion, to allusions to the vocals of rave music in the 80's, these artists refer to the audio culture of the near past to move beyond the stagnation of the present. This could be viewed as a form of nostalgia, a safe return to better times. However, Fisher positions 'hauntological music' somewhat differently, as a coming to terms with lost futures:

> 'The future is always experienced as a haunting: as a virtuality that already impinges on the present, conditioning expectations and motivating cultural production. What hauntological music mourns is less the failure of a future

[103] (Fisher, 2012) 16
[104] (Fisher, 2012) 16

to transpire—the future as actuality—than the disappearance of this effective virtuality.'[105]

SIRENIC VOICES: BURIAL

Of the work mentioned by Fischer, Burial's music became particularly important to me. The sensitivity and serenity of the music was quite unlike electronic music which I had previously heard. It is a music of internal and external worlds; speaking to the solitude, vulnerability and comfort one might feel when walking alone or riding the night bus through a vast metropolis that moves around you. Like Edward Hopper's *Nighthawks* (fig. 75), it is a veiled plea for bodies cut adrift in the city to overcome loss and find connection, to draw together into an intimate world of shared memory and collective experience.

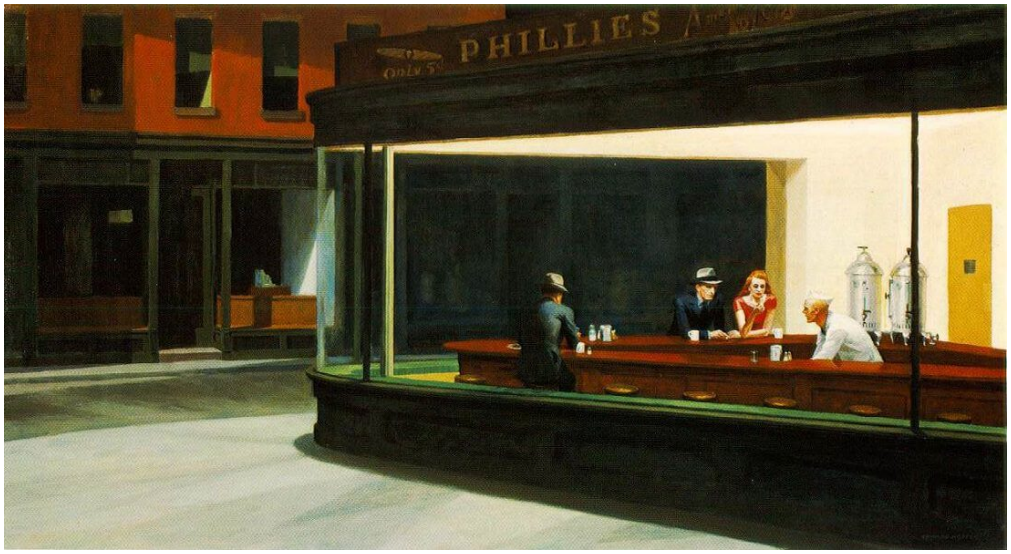


Figure 75 Edward Hopper's *Nighthawks*,1942 rep. (Hopper, n.d.)

[105] (Fisher, 2012) 16

One of the aspects of Burial's music that I am particularly drawn to is his use of ethereally pitch-shifted and stretched vocal samples. These voices are beyond gender and outside of time, mediating a message from beyond,

> 'I like vocals to be like that, like a night cry, an *angel animal*. Old hardcore tunes would throw these sounds in, anything to create the rush, the descent into another world. I love this one feeling, it only happens to you when you're out in the cold, when your down, this shiver attempts to warm you up, bring you back. For a moment you get this weird, eerie distant feeling like it's just for you.'[106]

As Burial describes, these voices are located in a realm between the human and nonhuman; sirenic songs drawing the listener into uncanny and mythic worlds. They signal to the listener that the music is located somewhere between the phenomenal world and the imaginary and reveal the role that technology plays in mediating our journey in-between. As Wolfgang Ernst describes,

> Sirens are "non-human" in terms of machinic or cyborg sound. What makes the mythological Siren motive relevant for present media archaeology of sound is the intervention of the phonograph, since for the

[106] (Mark Fisher, 2012)

> first time, the replay of recorded voices was considered like the presence of humans while at the same time knowing it is reproduced from dead signals on a storage medium and even more with electronic sound processing. Here, the uncanniness of the monstrous Sirens corresponds with the imaginary of technology itself.[107]

GHOSTLY VOICES: RAUDIVE

The belief that technologies mediate our relationship to the other can perhaps be traced back to Watson, who listened in amazement to the sounds of earthly signals when first using telephony to communicate over great distances. This belief was taken to the extreme (or the bizarre) by the Latvian parapsychologist Konstantin Raudive. Raudive conducted experiments into what he termed 'electronic voice phenomena' in the 1950's, using audio technologies to 'communicate' with the dead. Through tuning in to the static found between radio stations, he would hear the ghostly presence of deceased family members and historical figures, who would then pass on messages from beyond. The public interest in EVP has continued to

[107] (Ernst, 2016) 9

this day, with associations (such as the American Association for Transcommunication[108]), websites and internet chatrooms dedicated to providing 'evidence' that communication technologies can mediate relationships with the dead.[109]

Through researching all of the above, it became clear to me that conceiving of sonic technologies as conductive media is deeply embedded within the collective consciousness. From listening-in to the sound of the earth's electromagnetic field to parapsychological experiments, scientists, artists and countercultural figures alike have sought to bring forward invisible energies through sound media via technical means. The veracity of these experiments is of little concern to me. What interests me is the affects and temporalities that media make available through their inclusion in performative contexts. With their surfaces bearing the trace of nonhuman bodies, their mechanisms making time permanently available and their histories being knots of both personal and collective experience, media open up multimodal

[108] (https://atransc.org/, n.d.)
[109] (John E. Buckner, 2012)

engagements with the phenomenal world and help us to consider of our place within it.

TUNING BEYOND AUDITION

Following on from the above, I was looking to create a piece in which 'spirit voices' and electricity are interwoven within a fluid harmonic soundworld that is extended beyond the range of human hearing into pure physical presence. Having begun to explore relational pitch structures such as Tenney's arborescences, I was looking to root my harmony in sub audible frequencies whose oscillations would 'animate' sonic media without need for contact with a human performer. This extension and unfurling of pitch space would also dictate modes of engagement with sound producing objects. To my mind, this alluded to the collective consciousness of technology as conductive media and as storage devices for the nonhuman.

I began by setting the outer bounds of the harmonic world in which the piece would exist (fig. 76). These frequencies would function as the horizons of a harmonic world and would animate the sound media which would be brought alive by its

atmospheric condition. The frequencies I chose were 18.354 (D-1) (which is just outside of the range of human hearing) and 37588.8 (D11).

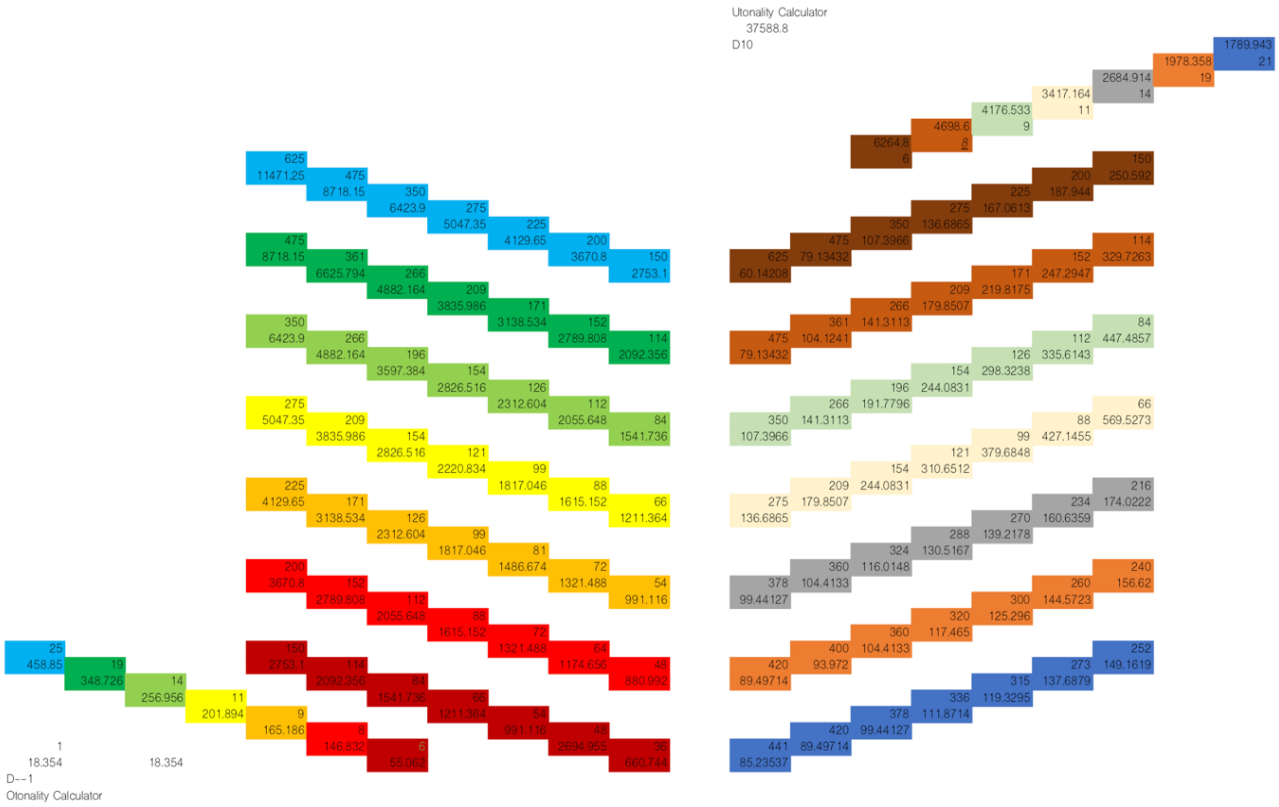


Figure 76 Otonality/Utonality 'wings', *angel | animal*

Out of the root frequency, eight branches emerge. The frequencies of these branches are arrived at through pure-ratio relationships with the root (as in Tenney). In the case of *angel | animal*, the 6th, 8th, 9th, 11, 14th, 19th and 25th partials of the D fundamental were chosen as a means of building harmony akin to a Imin-Vmin diatonic relationship. On the left side of the figure above, these frequencies are multiplied together to reveal further related frequencies which increasingly move away from the quasi-diatonic relationships of the partials chosen. On the right side

of the figure, the high D pedal undergoes the same process but in reverse, with the frequency being divided by the same ratio relationships. What arises out of this are a series of overtones and undertones which interpolate to form a complex web of possible frequential relationships, out of which emerge specific beating patterns and frequential relationships.

The sub audible root frequency was then transmitted via four sub-woofers positioned around the acoustic ensemble. The sub-woofers are prepared with Styrofoam 'cloches' which come into contact with the speaker cone to create unpredictable rhythmic patterns (fig. 77). Through automating amplitude, I could pass oscillations between the subwoofers, creating spatial movement amongst the sound producing bodies without the need for human performers to attend to them. This technique owes a debt to the work of Ashley Fure, who had pioneered this technique in her *Shiver Lung* series of works. As Fure describes, the preparation of subwoofers is a technique through which we can enter into a tactile relationship with the invisible (in this case the sound wave):

> At the heart of *Shiver Lung 3* are two subwoofer speaker cones doing their thing: moving up and moving down. But here, for the bulk of the piece, the subs are moving so slowly we can't actually hear the sound they make. Performers slide their palms and fingernails and chains and

pieces of paper and rattles and chimes across the surfaces of these subs while they shake, drawing them into the realm of audibility through touch. [110]

Figure 77 Subwoofer preparation in *angel | animal*

INSTRUMENTAL THINKING IN ANGEL | ANIMAL

A point of difference between Fure's use of subwoofers and my own is that there is no contact made between human performer and sound media in *Angel | Animal*.

[110] (Fure, http://www.ashleyfure.com/shiver-lung-3, n.d.)

I wanted the subwoofers to be perceived as discrete bodies which are animated by an internal sense of movement. This thinking then spilled out to the way in I approached the instruments of the ensemble. Rather than 'playing' the instruments, the performers tend to them, coaxing out their internal rhythmicity rather than overly subjecting the instrumental body to human will. Exciters, such as the circuit sniffer and the ebow were utilised to this end; to enter into active engagement with an instrument's electromagnetic field rather than imposing the force of the human body upon the surface of the instrument. Lastly, an electronic performer uses 'dynamic amplification' to access the interiors of the instrument's sound. Chunks of contact/close mic'd audio are distributed stereophonically via the p.a. to create a world in which the interior and exterior are simultaneously heard and in which performative action is not necessarily tied to sonic result. This sense of superimposed and differentiated sonic spaces is further supported by working with sounds at the extremes of the pitch-noise and dynamic continua, with blocks of loud distorted noise violently interrupting the ebb and flow of pure-ratio tuned sine waves and feedback (fig. 78).

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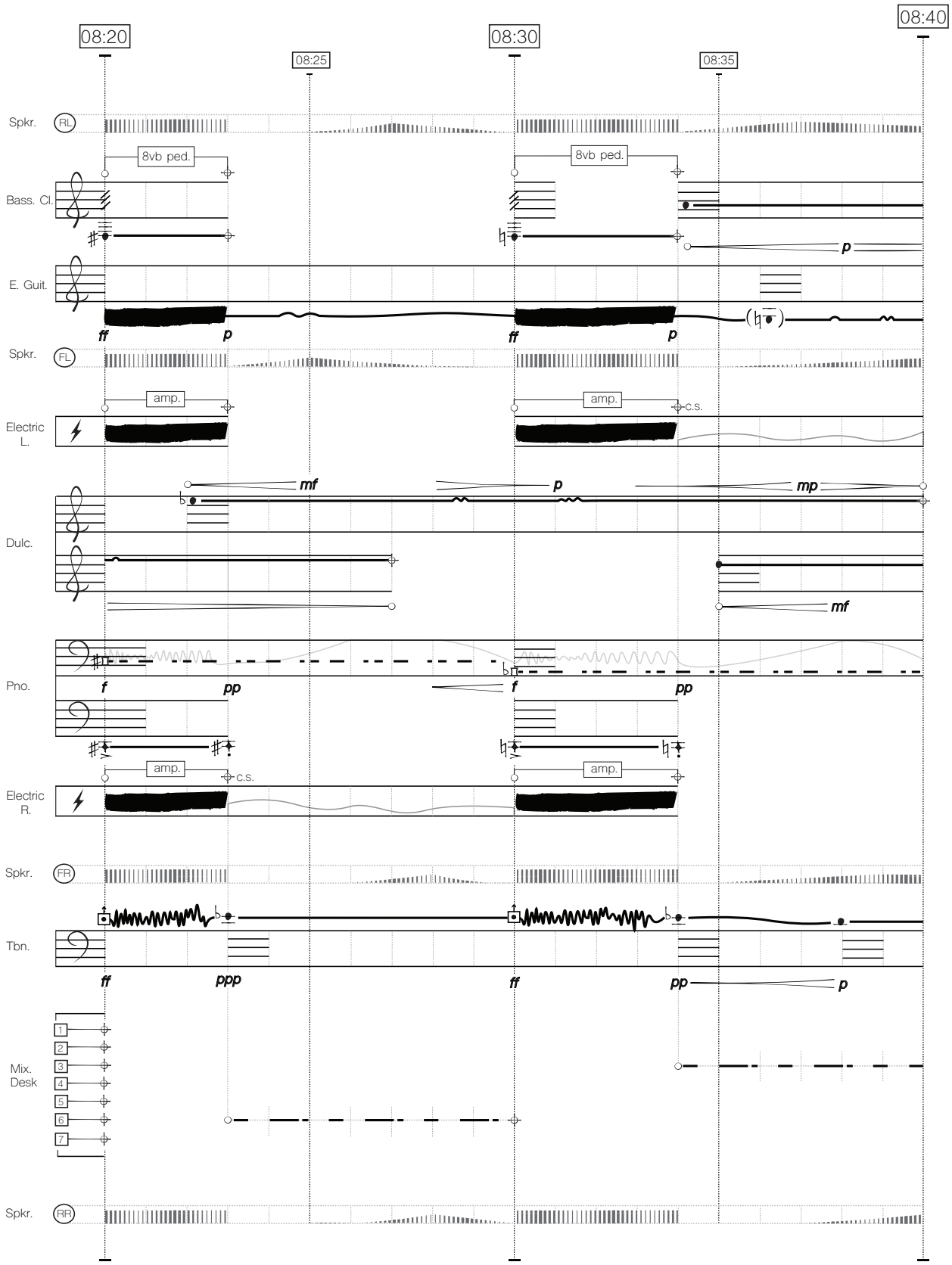

Figure 78 Distorted blocks, *angel | animal*, pg. 26

In summary, *Angel | Animal* is an exploration of sonic technologies that mediate a crossing from interior to exterior. Central to my thinking was the way in which these technologies *conduct*– how energy flows through them, is modulated, and projected into new spaces and bodies.

PROJECTIONS IN REAL TIME

I left Gaudeamus having had the opportunity to hear a number of my pieces performed in a short space of time. The three works presented at the festival– *Life of Lines II, the traces that remain* and *Angel | Animal*– had all included media haunted by memory. In *Life of Lines II*, music boxes emerge from within a braid of spectral sound. In *traces*, shellac discs are approached from a media archaeological perspective. In *Angel | Animal*, subwoofers are animated by invisible energies. What became apparent to me in hearing these works was both a predilection for reflecting on the technological imaginary of the past and the comparable ways in which form unfurled in these pieces. Threads of sound slowly intertwine, creating braids of sound which knot over the course of the piece. These braids are often cut across by external forces which reveal a wholly different perspective on the sound being

heard. These are either presented side-by side (as in the hard cut) or gradually morph into one another (as in the crossfade).

I was somewhat troubled by this. Whilst at the outset of this doctorate I had wanted to engender a radical overhaul in my compositional thinking, I had equally not been looking to develop a tightly wrought compositional methodology which would restrict my working with materials. I wanted to enter into dialogue with materials, to work within their field of forces rather than proceeding along formal lines which I knew would produce certain results. Moreover, I wanted to move beyond a meditation on the past toward exploring how it feels to be present, and to question where this presence might be located.

In the winter of 2018, I learnt that I had been awarded a Styria-Artist-in-Residency Scholarship by the Regional Government of Styria. The scholarship brings artists to Styria to work in close proximity with those active within the local art scene. I had been contacted by Schallfeld Ensemble, who were keen to develop a large-scale work together and so I began a period of residency in Graz which would lead to the development and performance of this new work in the winter of 2019.

THE PRESENT

What is the present? What does it mean to be here and now? Perhaps we imagine this graphically, that we are located at a specific point along a timeline. That the past is fixed, and that the future is an open space of possibility and future action. Our presentness is conditioned by memories which are located at points 'behind' us and anticipates a future at points further 'along'. This conception of time as a line; as a universal force which grinds along and is outside of ourselves, is deeply embedded in our language and culture. We speak about the flow of time, that the time has come, that it waits for no one and that we race against it. We see change, in our bodies and the bodies of others, and try to assimilate this into an understanding of how we should feel and behave in the now.

And yet, this now does not exist. It has already passed. Take for example, a conversation between two people. The sounds that come from the mouth of the speaker takes time to reach the ear of the listener. The moment has passed and has been updated by another moment, and another.

The forward-moving flow of these moments, as defined by Isaac Newton's arrow, has been systematically broken apart by mathematicians and quantum physicists. With Ludwig Boltzmann's reasoning that time moves equally well backward as

forward, and Albert Einstein showing that the placing of an event is in relation to the speed of movement, quantum physicists have gradually dismantled the structure of time, increasingly coming to the view that the universe does not proceed along a timeline.[111] Our everyday understanding of time is fundamentally at odds with the way in which the universe works. Carlo Rovelli, one of the founders of loop quantum gravity, has rewritten time as a property of the relationships held between bodies, rather than as an enduring, external force.[112] Time is a higher-level ordering of events, an *emergent* property of contact.

I began thinking about instrumental engagement in *Projections in Real Time*, by locating the present at the point of contact. I began by thinking through my body, about the way in which my hand interacts with the materials that I come into contact with. I created a scale of haptic explorations; notional points of contact between hand and object which access the present in specific ways (fig. 79). From this, I could derive a set of instrumental actions which would lead to multimodal engagements with the materials of performance, with the human performer needing to attune to the energetic forces of the bodies that they come into contact with. They would need to have an awareness that these bodies exert fields of force of

[111] (Callender, 2010)
[112] (Rovelli, 2019)

their own and that it is through energetic exchange– through the tensility of a relationship–that an action becomes a sound event. Each point of contact implicitly describes the pressure required to make these events an actuality.

STATIC CONTACT	LATERAL MOTION	PRESSURE	CONTOUR FOLLOWING	ENCLOSURE	UNSUPPORTED HOLDING
press	rub	knead	twist	mold	lift
stress	smooth	palpate	scrape	encase	heft
hold	erase	erase	skim		wield
rest	skim	pinch	peel		
touch	graze	press	rub		
		stress	caress		
		twist			
		peel			
		strike			
		rip			

Figure 79 haptic explorations, *Projections in Real Time*

I then used this scale of tensility/force to think through form. Following on from my awareness of the formal strategies that were so evident in my previously work, I wanted to start the piece with sounds already in motion, not with instrumental lines moving towards a point of becoming, but rather a sound situation already in a state of being. I wanted to create a continuous panel of sound in which points of contact are aggregated and overlaid, creating a rich and multidimensional sense of connection with and between sound objects. Multiple points of contact derived from the above would already be in motion when the piece begins, with the physical

limitations of the bodies involved dictating when to move between modes of engagement.

Through broad brush stokes, I outlined a form which would ebb between more or less 'pressured' sections (as demonstrated by the energy curve and spectrogram of fig. 80,81). Through using the binary code method first used in *yokobit*, I derived proportions from the metadata of the categories of haptic exploration mentioned above. At this point in my developing view on form, the length of these sections had become essentially arbitrary and might as well have been arrived at intuitively. I was no longer interested in perceiving architectonic formal relations but rather in exploring the textilic weave of materials in relation to the pattern of my practice. The categories of haptic exploration helped focus my engagement with instruments, and so, these were used as a way of getting the process going.

In the first section, 'Wall of Sound', static contact is the primary mode of contact. This type of contact gives rise to heat flow between skin and surface. With total lack of motion being an impossible state of being, I decided to conceive of this as the coming into contact with internal oscillation and vibration. Each instrument has continual contact (as far as is possible) with the surface of a particular sound. The result of this contact, may or may not, produce a continuous sound result. For example, the continuous contact between a fibre, threaded through the strings, and

the strings of a cello, produces pops and cracks which are unstable and discontinuous. Whilst continual contact is being made between activator and resonator, it requires more or less pressure by the performer for this sound to speak. The PVC pipes, in combination with a blown instrument and a bucket of water, are used to similar effect in the woodwind parts. Whilst continual contact between the mouth and the pipe is maintained (within bodily possibility), it is the haptic contact between pipe and water surface that leads to an unstable and oscillating sonic result. The piano also maintains continual contact, between a glass bowl and the strings of the instrument. Through slowly rotating the bowl, unpredictable harmonic sweeps emerge. The percussion similarly explores the surfaces of sheet metal to produce a wide range of frequencies, depending on the pressure and placement of their contact point.

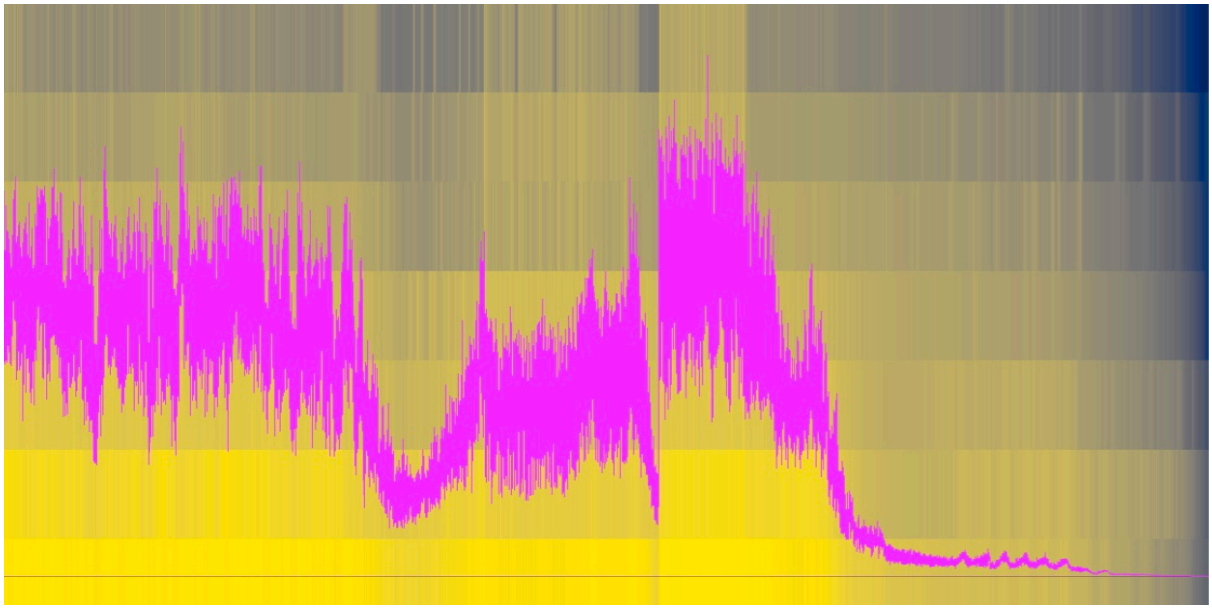

Figure 80 *Projections in Real Time*, visualisation of RMS energy curve and spectral mean

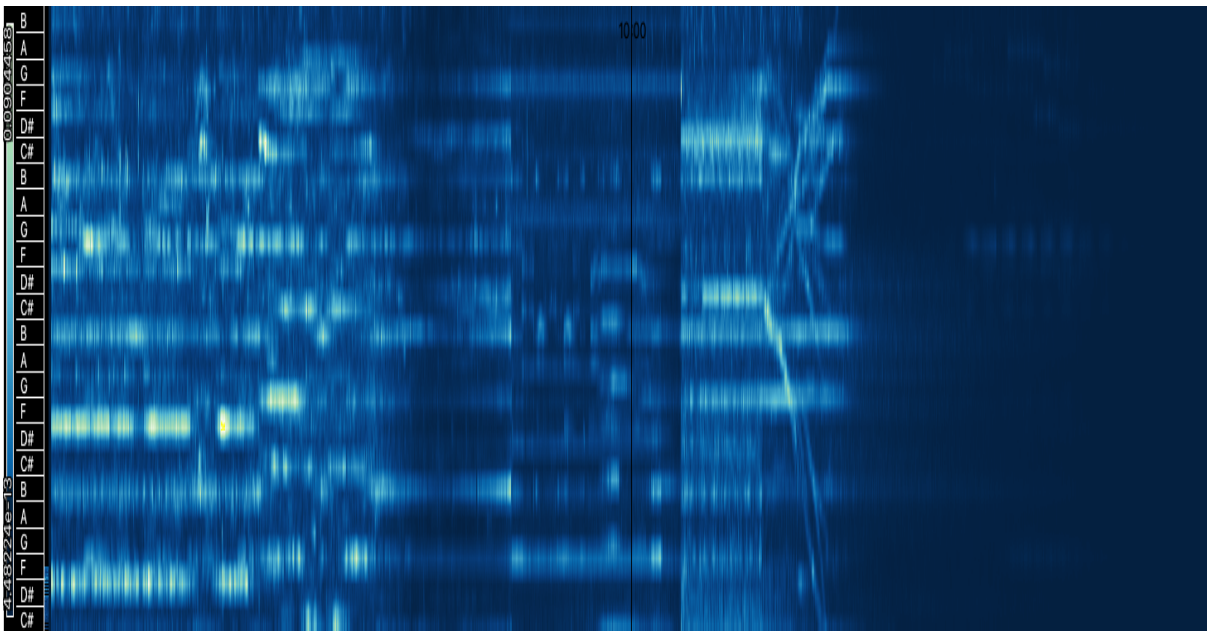

Figure 81 *Projections in Real Time,* constant 'Q' spectogram

NOTATION IN *PROJECTIONS*

As can be heard in the above, the information needed to be passed to the performers was less about a complex and shifting set of pitch and unpitched behaviours. A mixed notational strategy such as in *angel | animal* would have served this to good effect, but I wanted to indicate morphology within a singular action. Having explored morphological notations (for example, in *Grain of the Voice*) in previous work, I decided to turn to this for the score surface of *Projections*. I became particularly interested in the way in which Pierre Schaeffer's spectromorphological typology articulates sound energy, spectral content and stability of a sound (fig. 82): [113]

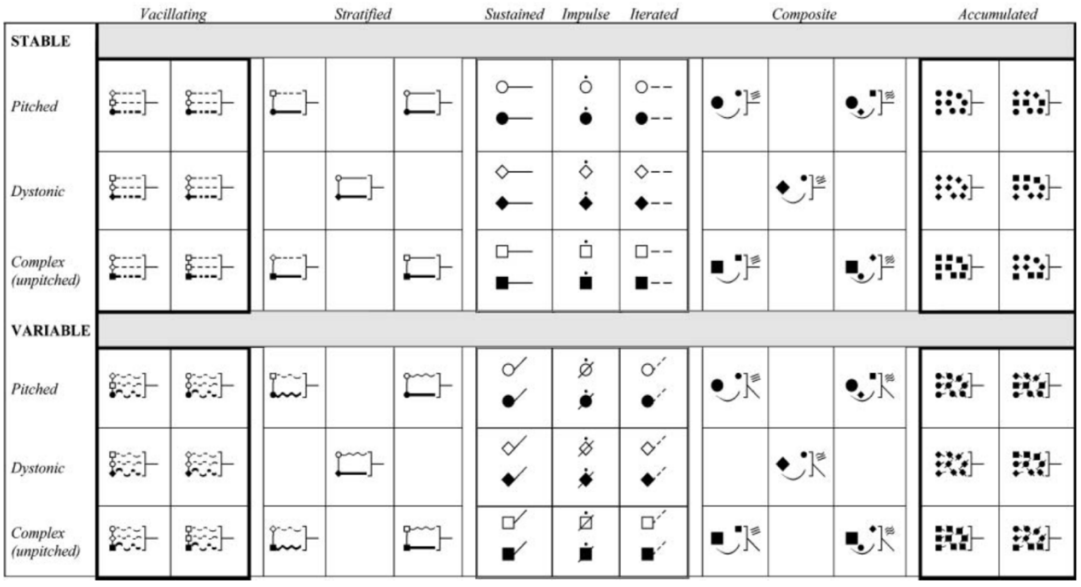

Figure 82 Pierre Schaeffer's spectromorphological typology, rep. pg. 134 (Thoresen, 2001/2004)

[113] (Hedman, 2007)

I incorporated this into my own thinking, with compound symbols being used to indicate an initial action, the spectral density of the sounding result and whether that sound should be continuous or discontinuous. For example, in the percussion part seen in fig. 83, a complex unpitched sound with vacillating internal energy should be produced. The lines that emerge from the symbol indicate length of the action and the desired spectral density, although this is subject to change when modulated by the material qualities of the instrumental body.

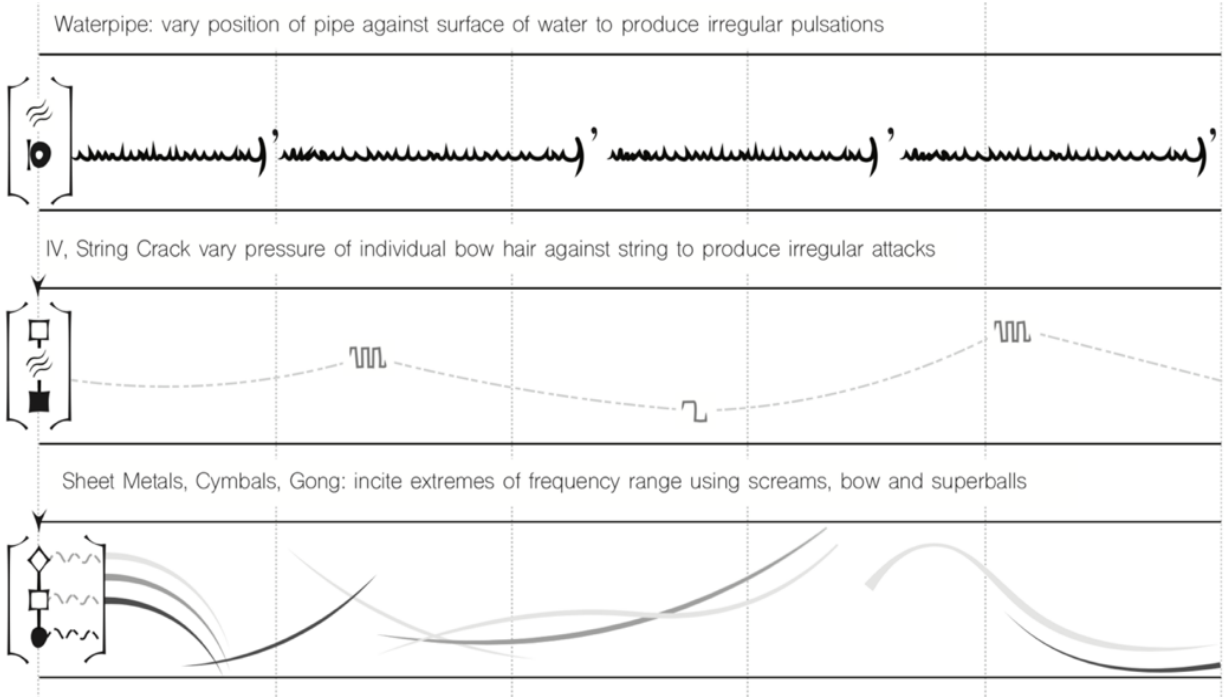

Figure 83 *Projections in Real Time* spectromorphological notation, perc., cello, b. clarinet

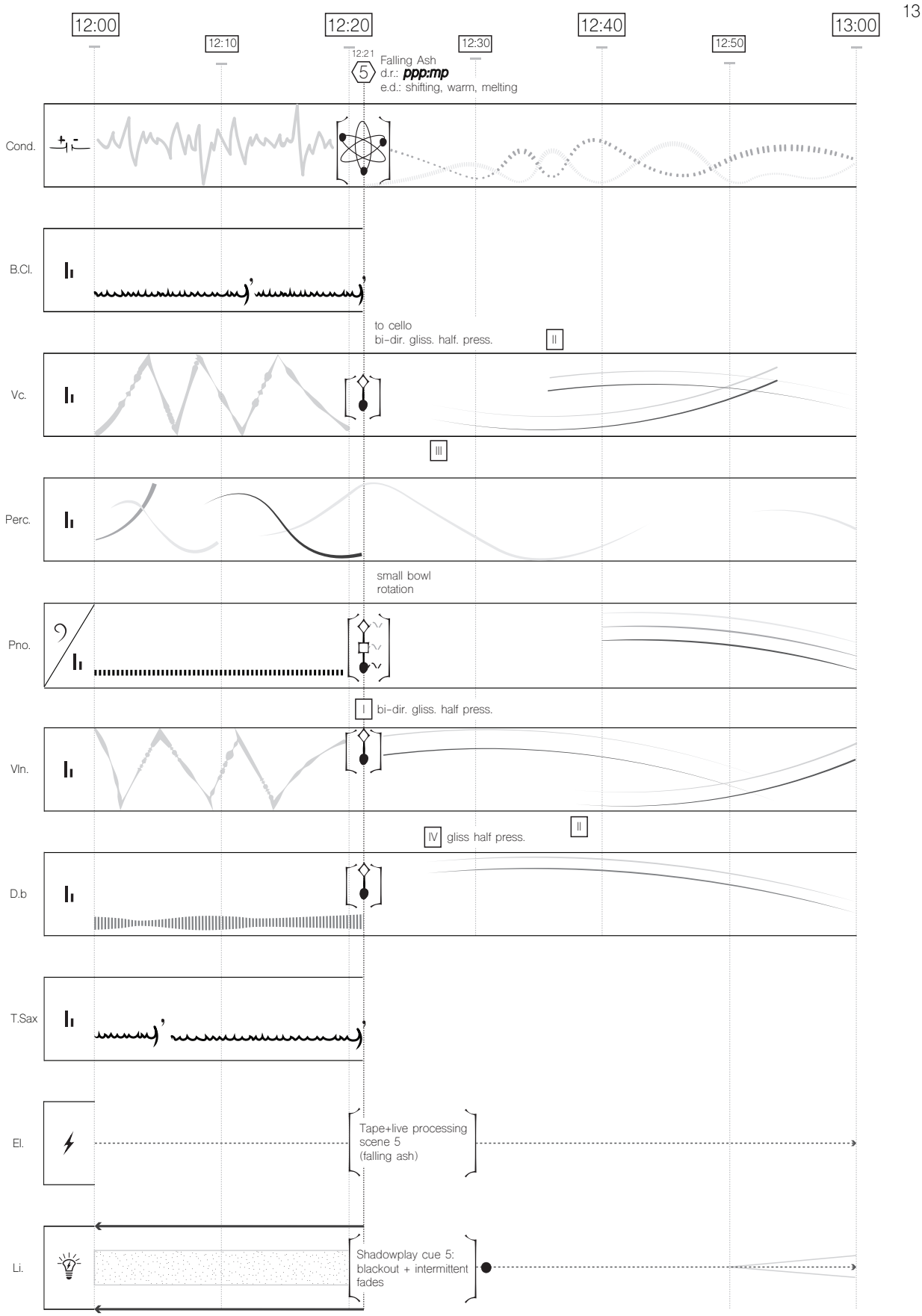

Figure 84 *Projections in Real Time*, pg. 13, demonstrating a variety of morphological behaviours

CONDUCTION

Through the above, I had found a means of articulating local sound energy and an approach to the instrumental body. However, I was aware that a higher-order structuring of events may be needed to guide the energetic flow of the result in relation to the electronics component.

Schallfeld work regularly with a conductor. Having latterly almost completely abandoned metre, discrete rhythmicity and synchronous sound events, I needed to ask myself how a conductor might perform my music. I have no interest in a human performer playing the role of timekeeper or clock, nor do I see a great deal of appeal in watching a performer metre sounds which are by their nature volatile and should be left unbound. However, I am interested in chains of causality, in which the sound produced by one performer leads to energetic shifts of the whole (think, for example, of the morphing causal chains of *Grain of the Voice* or the dynamic amplification of *angel | animal*). In light of this, I decided to employ the conductor of Schallfeld to articulate the global sound energy. Their role in the piece is to coax out timbral and dynamic change through 'conduction' gestures, rebalancing the sonic energy in accordance with the score and the fixed electronic component. Their instrument would be the ensemble as a whole, viewed as a meta-mechanism with discretely moving sonic components. They use their physicality to embody the

sounds heard, to indicate action when required, and to shape the aggregate of all sounds produced according to their sonic imagination. This type of approach was informed by the work of Iancu Dumitrescu, who uses conducting as a means of modulating timbre through bodily action,[114] and the live composition of 'Sound Painting', pioneered by Walter Thompson.[115] In Dumitrescu's work, a causal chain is established, where energetic flow is modulated through collective decision making.

MULTIMEDIA SITUATION IN *PROJECTIONS*

Having decided upon this, I started to think about the visuality of the piece more broadly. With a great range of activators and preparations used throughout, there was a danger in opening up the visual field to associations quite outside the frame of the work. I felt that the piece would be best served if their qualities were contained within the sonic. For example, watching a performer bow a Styrofoam cup produces its own series of associations which in this instance would be counter to the affective totality of the actions of the performers and the sound world being

[114] (Dumitrescu, Sound Source, 2011)
[115] (Thompson, 2017)

produced. With my ongoing interest in collapsing the distance between the acoustic and electronic, I was looking for a way of veiling the points of contact from public view, and being able to establish an acousmatic situation in which the listener is not sure of where the sound is being produced, and from whom. This was partially in response to a further concern that I had felt in my work with sound media thus far. Whilst the inclusion of historical sound media in the context of performance produces association and memory, it also seemed to reduce the perception of these objects as technologies capable of producing complex sound results. Whilst contemporary music audiences seem to ignore this in relation to the piano (which has also been historically found in the home) it seemed more problematic in relation to the gramophone. On the one hand, I was keen to explore the associative qualities of these media, on the other, I found myself losing the sound. I therefore decided to obscure the visual scene in *Projections* through the use of screens. Using a variety of lighting states, the silhouettes of the musicians would at times be clearly visible, at others, their shadows would aggregate into compound bodies which move in ways atypical of an instrumental ensemble.

The screen, of course, has its own medial history, primarily located in the projection of film. To view a body through a screen is to view the trace of ossified movement.

Film does not so much as produce bodies, as much as generating lost bodies.[116] Moreover, the photographed body is in tension with the physical world, with movements being imposed upon them by the technique of the filmmaker and technological apparatus- the camera, the light and the film editing suite. The profilmic body is a photographic marionette, a hybrid body that oscillates between physical and cinematic worlds.[117]

The distance between the affective virtuality of the body viewed through screen, and the physical body is something that I am greatly interested in. It speaks to the interiority and exteriority of media worlds, and the view of audio-visual technologies as conductive, communicative media which can bridge space and time. While my initial thought had been to focus solely on sound, I had arrived at a multimedia situation which was much more complex and nuanced, and produced temporalities of its own.

To my mind, there is an interesting friction between the focus on locatedness and presence in the performative parts, and the way in which the screen and lighting stages project this action. On the one hand, there are direct connections, for example, the way in which the intensity of light is positively correlated to the

[116] (Lippit, 2012) 121
[117] (Lippit, 2012) 126

amplitude of sound being received through particular microphones. On the other, the quasi-stroboscopic effect used throughout the piece creates visual situations in which our experiencing of movement slows, and we are presented with a granular visual scene treated almost as photographic stills. The movement between these two modes serve to both reveal and distort the action and provides a complex view on the sounds being produced. The shadows of the performer's bodies reveal the pressure required to perform actions, whereas the lighting and screen apparatus serves to collapse the distance in between independent bodies (fig. 85).

Figure 85 *Projections in Real Time*, screens

Lastly, I was looking for the screens to be more than two-dimensional surfaces, but also bodies that can be instrumentalised and interacted with. At the conclusion of the piece, the wind performers leave their instruments and touch the screen through arc-like movements to filter vocal sound files (fig. 86). The vertical axis corresponds to the Q point of the filter, the horizontal axis to the frequency centroid. DMX lighting control and Kinnex motion sensors were used in the first performance to achieve the above.

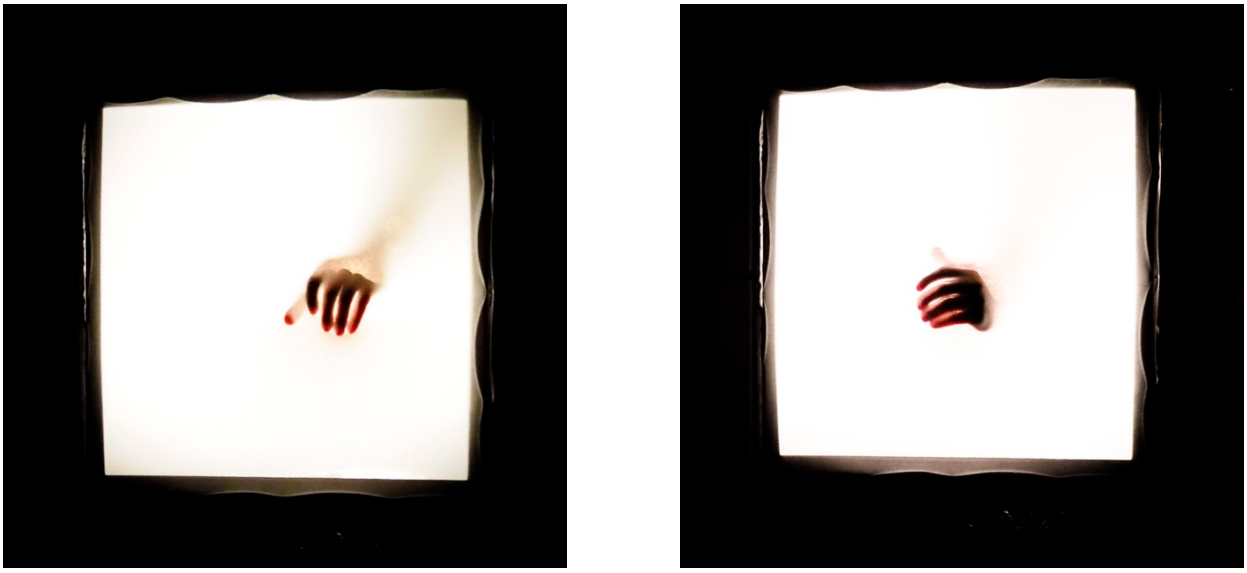

Figure 86 *Projections in Real Time*, interactive screens

THE PITCH-NOISE CONTINUUM

The instrumental sound world of *Projections* is by and large noisy. This marked the fulfilment of a particular strand of compositional thought that had been growing throughout this body of work; that the sounds produced by instrumental bodies

were unruly and dynamic and should be treated as such, and that abstract materials, such as harmony, were best rendered through inorganic sounds such as the sine wave. Having used sine waves from *traces* onward, I had become a little frustrated by the lack of internal movement with this sound. Whilst I could automate the shape of their amplitude, I could not create more complex internal morphologies outside of using synthesis techniques to make a more complex spectrum. As a result, the fixed electronic component in *Projections* brings together sine waves, tuned feedback produced by a no-input mixing desk, and single-band filtered jet engines, alongside sounds of the Serge synthesizer. This results in dynamic and complex sounds with a clearly audible frequency centroid. The morphologies of these sounds are also complex, moving dynamically within the bandwidth. When aggregated together and having undergone processes of transformation, an intense and interwoven mass of sound emerges. The instrumental sounds of the ensemble are also amplified, transformed and added to this mass. Together, they are diffused through the p.a. system to create a sonic situation in which the distance between the acoustic and electronic domains collapse.

Through all of the above, a multimedia situation manifests in which sound, light and physicality melt into one, where directionality is foregone in favour of soaking in a sonic and actional present.

SUNSET, MELT, DOWN

Following the completion of *Projections*, I began to write this commentary. I had every intention of concluding my portfolio here, with the piece drawing together strands of compositional thinking developed over five years or so. What struck me when writing up all of the above, was the growing desire to create sonic situations in which spontaneous creation leads to unexpected results. Agency had been distributed since *Life of Lines II* and had culminated in *Projections*, whose notation serves to guide improvisatory action and encourages the performers to focus on their haptic relationship to their instrument, and to listen to one another within an immersive sound environment.

In the course of gathering materials together to support my line of thinking, I stumbled upon a recording of an organ improvisation that I had made at Harvard in September 2018. It had been my intention to return to this at some point, but the opportunity had never presented itself, and I subsequently forgot about it and busied myself with other projects. At the point that we now reach, it began to feel increasingly appropriate to include a last piece– one that documents a moment of my own spontaneous creation. I therefore decided to return to the recording of this organ improvisation as an artefact that documents such a moment. I decided to use

this as the basis for a final work, that would be included as an addendum to the portfolio of works and commentary.

Figure 87 improvising with organ stops for *sunset, melt, down* in Memorial Church, Harvard 2018

It is perhaps fitting that I return to the organ at the close. I have been drawn to the instrument for as long as I have been a musician, having often worked with tonewheel organs and simulations as a keyboard player throughout my teenage years. In many ways, the instrument can be considered to be the prototypical synthesizer, with the ability to develop complex timbral morphologies through its systems of stops. An organ-like approach to timbre also corresponds to my use of additive synthesis methods throughout the latter parts of my portfolio, with tone oscillators and feedback being used as the fundamental component to develop more complex timbres and harmonies.

Upon arriving at Harvard in 2018, experimenting with the organ was one of my initial aims. In the end, this happened only once. I spent a September afternoon in Memorial Church looking to create a slowly morphing panel of sound solely through the use of the stops (fig. 87). I decided to 'prepare' the manual with pencils, creating a chordal complex that could be added to or subtracted from, depending on the stops in use (fig. 88). The result of this is eleven minutes of improvised material, that has been used as the basis for *sunset, melt, down*.

Figure 88 pencils holding down manual of the organ

When deciding to include this in my portfolio, I began by asking what shape or form this might take. Should a score be retrospectively annotated, or would I add additional layers of material? To what degree do I consider this a piece, or as

supporting documentation for the other works found in the portfolio? Reflecting on these questions made me aware of the remnants of traditional formal biases that I did not know that I was still carrying. My hesitancy to think of *sunset* as a 'piece' lay in the fact that there was no physical artefact, that it was created in a much shorter span of time than the other pieces, and that it did not seek to follow, or bend, a formal framework that I had prefigured. Considering the fact that I had been searching for a particular type of 'liveness' throughout much of the portfolio, this seemed counter indicative to the ethos that I was trying to foster. Although it is perhaps less detailed than the work made subsequently (in phase 3), I found it to have a quality that I was equally compelled by. Taking all of the above into consideration, I decided that it deserved to be included as is. I also felt that a score would only serve to artificially render a spontaneous act and should therefore not be made. I decided to create a work that sits in a hybrid space between improvisation and composition, with more formal working with electronics complementing the intuited form of the organ material.

I began by deciding to work with a highly reduced pallete of sounds, in which the organ would be inseparable from the electronics. Over the course of the piece, the electronics would emerge as internal voices from within, and would follow a morphological path incapable of being produced by the organ. This type of thinking

is based on exposing organological difference and can be found in various guises throughout the portfolio (beginning with *Our Heads)*. The electronics would comprise solely of sine waves and electronic devices that could produce drones with complex spectra. Through combining the sound of the organ and these electronic components, a dense weave of beatings would emerge. To achieve this, I began by creating overtone/undertone arborescences derived from the harmonics heard in the organ material. The 32nd, 36th, 40th, 45th, 48th, 52nd, and 60th partials were used as the roots for frequencies extending outward into harmonic space (fig. 89). The fundamental frequencies are just beyond the threshold of audibility– 16.3515 (C) and 16768 (E).

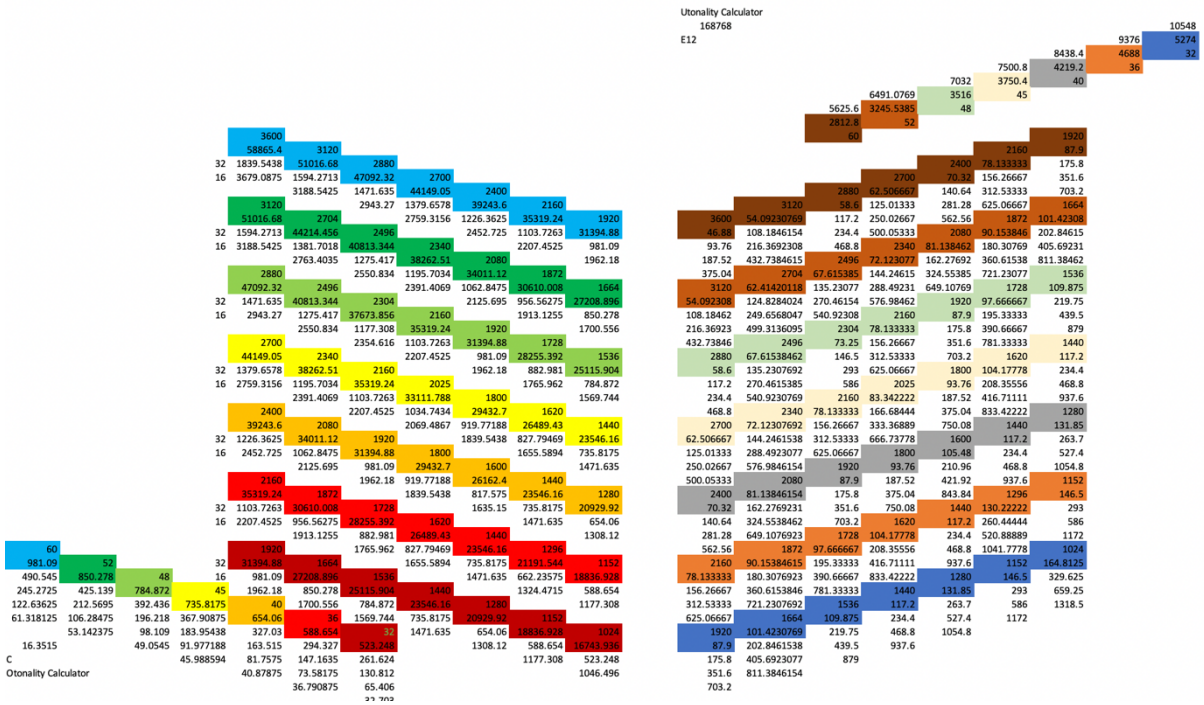

Figure 89 harmonic arborescences for *sunset, melt, down* (overtones on the left, undertones on the right)

These frequencies were then assigned to tone oscillators which are carefully braided within the organ's naturally occurring beatings and vibrato. Their amplitude follows processes of dynamic growth that cannot be found in the organ's drone like material. This gives the improvisation a directionality which was hitherto missing. Electronic devices were tuned by ear, creating complementary beatings that were outside of both the sound of the organ and the more formal ratio-derived tuning of the harmonic arborescences. Over time, the frequencies of the electronic devices ascend through pitch space via glissandi, resulting in lines that follow their own trajectory and give life to the slowly shifting drone of the organ. The global result is a dense block of interwoven sound. The organ initially obscures layers of movement, which subsequently unfurl and are revealed as we move further into the harmonic space.

In creating a form from within an improvisation, *sunset, melt, down* is a work which seeks to prolong and expand upon a singular moment. The working method is one in which improvisation is met and redirected by process while forgoing much of the prefigurement that underpins the rest of the portfolio. It opens up a world of possibility for my future practice, in which forms emerge spontaneously and are intuitively worked upon, building up a rich and multi-layered surface of material encounters

Afterword

It is with excitement that I loop back around to where I started, with questions and few answers; with work to be made and little more than an intimation of the direction this will take me in. Having variously addressed rhythmic entrainment, temporal stratification, temperament and tuning, phenomena of the relational and theories of mediation, I now find myself in a position in which the threads of my compositional thought are needing to be untied and tangled anew. New paths of discovery are opening up before me as I follow my intuition and am guided by the pattern of my practice. More than anything, reflecting on the work undertaken over the course of five or so years has shown me that so much, and yet so little, has changed. The radical overhaul of my practice has served to highlight just how much more work there is to be made and that sound has so much more to teach me. This is the beginning.

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